IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF ILLINOIS

UNITED STATES OF AMERICA,

Plaintiff,

v.

APEX OIL COMPANY, INC.

Defendant. **No. 05-CV-242-DRH**

ORDER FOLLOWING BENCH TRIAL

Herndon, Chief Judge:

INTRODUCTION

The United States brought this action under the endangerment provision of the **Resource Conservation and Recovery Act ("RCRA"), RCRA Section 7003, 42 U.S.C. § 6973**, seeking injunctive relief requiring Apex Oil abate the existing and potential threats to human health and the environment posed by an accumulation of subsurface petroleum hydrocarbons contaminating soil and groundwater beneath Hartford, Illinois. The evidence presented at a 17 day bench trial that began on January 7, 2008 establishes Apex Oil's liability under **RCRA Section 7003** and the appropriateness of the requested relief.

FINDINGS OF FACT

I. Hartford Refinery - Early Ownership

1. The Village of Hartford is located in Madison County, Illinois on the east bank of the Mississippi River, approximately twelve miles northeast of St. Louis, Missouri. (Pl. Ex. 143 at APEXDEPO_005359). According to the 2000 census, Hartford has a population of 1,545 people. (Pl. Ex. 143 at APEXDEPO_005359).

2. In 1940, Wood River Oil & Refining Co, Inc., a Kansas corporation now known as Koch Industries, Inc. ("WROR"), constructed a refinery on what is now known as Hawthorne Street in the northeast section of the Village of Hartford, Illinois (the "Hartford Refinery"). (Uncontroverted Facts at Para. 1). The Hartford Refinery opened on or around March 1, 1941. (Uncontroverted Facts at Para. 1). Historically, the Hartford Refinery has also been identified as the "Wood River Refinery." (Uncontroverted Facts at Para. 1).

3. On June 27, 1950, WROR and Sinclair Refining Company ("Sinclair Refining") entered into an agreement whereby, among other things, WROR agreed to sell the Hartford Refinery to Sinclair Refining. (Uncontroverted Facts at Para. 2). The sale closed on or around June 30, 1950. (Uncontroverted Facts at Para. 2).

II. Clark Oil and Refining Corporation / Apex Oil Company, Inc.

4. On or around September 29, 1967, Sinclair Refining sold the Hartford Refinery to Clark Oil and Refining Corporation, a Wisconsin corporation ("Clark Oil"). (Uncontroverted Facts at Para. 3).

5. Apex Oil Company was a Missouri general partnership formed in 1979 ("Old Apex"). (Uncontroverted Facts at Para. 4). On October 23, 1981, Clark Oil was merged into Apex Acquisition, Inc. (an indirect, wholly-owned subsidiary of Old Apex) and Apex Acquisition, Inc. subsequently changed its name to "Clark Oil and Refining Corporation" ("Clark Oil-Apex"). (Uncontroverted Facts at Para. 5)

6. On December 24, 1987, Old Apex and most of its subsidiaries (including Clark Oil-Apex) filed for protection under Section 301 of Chapter 11 of the United States Bankruptcy Code, 11 U.S.C. § 101 et seq., in the United States Bankruptcy Court for the Eastern District of Missouri, Eastern Division, Case No. 87-03804-BKC-BSS. (Uncontroverted Facts at Para. 6).

7. On November 20, 1988, Clark Oil-Apex sold the Hartford Refinery to "Clark Oil and Refining Corporation" (initially known as "AOC Acquisition Corporation" and subsequently known as the "Premcor Refining Group Inc." ("Premcor")) in a sale approved by the Bankruptcy Court. (Uncontroverted Facts at Para. 7).

8. Apex Oil Company, Inc. ("Apex Oil") was incorporated on November 16, 1989 and Clark Oil-Apex was merged into Apex Oil on December 12, 1989. (Uncontroverted Facts at Para. 8). Apex Oil is a successor-by-merger to both Clark Oil and Clark Oil-Apex, who collectively owned the Hartford Refinery between September 29, 1967 and November 20, 1988.[1] (Uncontroverted Facts at Para. 9).

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[1] Since there were three corporations with the name "Clark Oil and Refining Corporation" that have owned the Hartford Refinery, they are referred to herein as Clark Oil,

III. North Terminal

9. On September 29, 1948, Sinclair Refining acquired property to the northwest of the Hartford Refinery for the purpose of building a tank farm and terminal facilities (the "North Terminal") and a pumping station ("Pumping station") for a pipeline that travelled west across the Mississippi River to Oklahoma. (Uncontroverted Facts at Para. 10). At an unknown date, the North Terminal was tied into the Marathon Pipe Line system. (Uncontroverted Facts at Para. 10). When Sinclair Refining sold the Hartford Refinery to Clark Oil in 1967, it retained the North Terminal and the Pumping Station. (Uncontroverted Facts at Para. 11).

10. Sinclair Refining was merged into Sinclair Oil Corporation on September 30, 1968. (Uncontroverted Facts at Para. 12). On March 4, 1969, Sinclair Oil Corporation merged into Atlantic Richfield Company ("ARCO"). (Uncontroverted Facts at Para. 12). On or around August 3, 1976, ARCO sold the North Terminal to Keller-Piasa Terminal, Inc. ("Keller-Piasa"). (Uncontroverted Facts at Para. 12). ARCO retained the Pumping Station. (Uncontroverted Facts at Para. 12). Subsequently, Keller-Piasa sold the North Terminal to the Hartford/Wood River Terminal Company. (Uncontroverted Facts at Para. 12).

Clark Oil-Apex, and Premcor irrespective of their actual names from time to time. As Apex Oil is a successor by merger to both Clark Oil and Clark Oil-Apex, their period of ownership of the Hartford Refinery, September 1967 through November 1988, is referred to herein as the "Clark/Apex Era."

IV. Hartford Refinery Pipelines

A. River Lines

11. To provide for barge transportation of its products, WROR built a dock on the Mississippi River west of Hartford and constructed product pipelines between the Hartford Refinery and the dock. (Uncontroverted Facts at Para. 13).

12. By Ordinance No. 232 adopted by the Village on January 7, 1944, Hartford granted WROR the right to lay three 8-inch pipelines and one 3-inch pipeline underground through the Village, travelling north along the east side of North Olive Street and then west along the south side of Elm Street to the west side of North Old St. Louis Road (the "River Lines" or "Original River Lines"). (Uncontroverted Facts at Para. 14). One of the 8-inch lines was designated for transporting gasoline, one was for distillates (#1 and #2 fuel oil), and one was for heavy oils. (Uncontroverted Facts at Para. 15).

13. The Original River Lines were bare and lacked protective wrapping used to prevent corrosion. (Faryan Test. Day 1 at 102-03). The Original River Lines suffered numerous leaks during the Clark/Apex Era. (<u>See</u> Section XI, below). In April or May 1978, Clark Oil ceased use of the gasoline and distillate lines, at which time those lines were water washed, air blown and blinded off. (Uncontroverted Facts at Para. 16). Clark Oil continued to utilize one of the Original River Lines for the transfer of heavy oils. (Uncontroverted Facts at Para. 17).

14. In 1982, Clark Oil-Apex had new pipelines consisting of one 10-inch gasoline line, one 10-inch fuel oil line, one 10-inch spare line, and one 14-inch black

oil line designed and installed (the "Replacement River Lines"). (Uncontroverted Facts at Para. 18). The Replacement River Lines became operational in late 1983. (Uncontroverted Facts at Para. 18). The Original River Lines were left buried in place. (Uncontroverted Facts at Para. 18).

B. North Terminal Lines

15. On August 5, 1952, the Village adopted Ordinance 310, which allowed Sinclair Refining to lay two 10-inch pipelines along and beneath the easterly edge of North Olive Street from a point approximately 50 feet south of the center line of Forest Street to Rand Avenue, then west along the south side of Rand Avenue, and then crossing Rand to the North Terminal property ("North Terminal Lines"). (Uncontroverted Facts at Para. 19). In 1952, Sinclair Refining laid the two 10-inch diameter North Terminal Lines, one for gasoline and one for fuel oil, underground between the Refinery and the North Terminal. (Uncontroverted Facts at Para. 20).

16. Sinclair Refining (later known as ARCO) may have retained ownership of one of the North Terminal Lines following the sale of the Hartford Refinery and associated pipelines to Clark Oil in 1967, although this pipeline would have been inactive.[2] (Pl. Ex. 53).

17. Clark Oil used the North Terminal Line to make deliveries to the North

[2] As one of the two 10-inch North Terminal Lines was inactive during the Clark/Apex Era, regardless of whether it was owned by Clark Oil or ARCO, the various leaks and repairs referred to below all occurred on the other 10-inch pipeline. References to "North Terminal Line" in the singular refer to the 10-inch line owned by Clark Oil from 1967 to 1979 and by Sinclair Marketing thereafter.

Terminal and the Pumping Station and to make deliveries to Marathon Pipe Line, which was connected to the North Terminal. (Uncontroverted Facts at Para. 21). The North Terminal Lines were bare, lay 3" to 5" apart, and no active corrosion program was carried out on the lines by Clark Oil. (Pl. Ex. 26 at APEXDEPO_001847; Gustafson Test. Day 7 at 232-33). The lack of a protective coating on the pipeline (i.e., being "bare") made the line susceptible to corrosion. (Gustafson Test. Day 7 at 233). The North Terminal Line suffered numerous leaks during the Clark/Apex Era. (See Section XI, below). The North Terminal Line was formally abandoned by Clark Oil on May 3, 1978. (Uncontroverted Facts at Para. 21).

18. In December 1979, Clark Oil agreed to sell the North Terminal Line to Sinclair Marketing, Inc. ("Sinclair Marketing"). (Uncontroverted Facts at Para. 22). On December 28, 1979, pending finalization of such sale, Clark Oil agreed to allow Sinclair Marketing to utilize the North Terminal Line to transport petroleum products. (Uncontroverted Facts at Para. 22). The sale by Clark Oil of that pipeline to Sinclair Marketing was completed on September 28, 1981. (Uncontroverted Facts at Para. 22).

V. Hartford Refinery Operations

19. As of 1976, the Hartford Refinery had the capacity to process 53,000 barrels of crude oil per day. (Pl. Ex. 246 at PRG.DOJ08259, 270; Gustafson Test, Day 8 at 16-17). By 1986, crude processing capacity at the Hartford Refinery had increased to 60,000 barrels per day. (Pl. Ex. 77 at APEXDEPO_002138).

20. A barrel of petroleum (or a refined petroleum product such as gasoline) is a unit of volume that equates to 42 gallons. (Gustafson Test. Day 8 at 43).

21. During the first-half of 1973, the crude oil throughput at the Hartford Refinery averaged 37,580 barrels per day. (Pl. Ex. 246 at PRG.DOJ08263; Gustafson Test Day 8 at 17-18). In 1983, the Hartford Refinery's average crude charge was 43,939 barrels per day. (Pl. Ex. 160 at IEPA000200). For the period from January 1984 through March 1986, the Hartford Refinery's average crude charge was 47,946 barrels per day. (Pl. Ex. 77 at APEXDEPO_002166).

22. Petroleum products produced by the Hartford Refinery included: leaded gasoline, unleaded gasoline, No. 2 Fuel Oil, and Six Oil. The 1983 production figures for these products were:

Leaded Gasoline	5.3 million barrels
Unleaded Gasoline	6.5 million barrels
No. 2 Fuel Oil	4.8 million barrels
Six Oil	1.0 million barrels

(Pl. Ex. 160 at IEPA000202).

VI. Other Area Refineries

23. The former Amoco refinery (the "Amoco Refinery") situated north of the Hartford Refinery, opened around 1907, closed in 1981, and is now dismantled. (Uncontroverted Facts at Para. 24).

24. The former Shell Oil Co. refinery (the "Shell Oil Refinery"), situated just east and northeast of the Hartford Refinery, opened in 1918 and is currently operating under the ownership of ConocoPhillips, Inc. (Uncontroverted Facts at Para. 25).

VII. Geology Beneath the Village of Hartford and the Refinery

A. Site Geology Has Been Influenced by Proximity to the Mississippi River.

25. Geology in the area of the Village of Hartford and the Hartford Refinery is dominated by proximity to the Mississippi River. The environment beneath the Site is a mixed-load, river avulsion zone, where the Mississippi River has historically breached its natural flow, splaying sediments and creating new channels in the flood plain. This process deposited widely variable sediments ranging from finer grain deposits to course sands, generating an inter-mixed distribution of sand, silt, and silty-clay layers across the Site. (Howe Test. Day 6 at 34, 40; Pl. Ex. 168 at EXPRT000186-187).

B. The Main Sand Is Predominant Throughout the Site

26. The predominant geologic feature beneath the Village of Hartford and

the Hartford Refinery is the Main Sand, a massive, very porous, permeable sand which underlies the entirety of Hartford and surrounding areas. (Howe Test. Day 6 at 31; Pl. Ex. 203 at EPA_RPT038415; Sharma Test. Day 14 at 116). The Main Sand is a very coarse-grained sand, with some silty elements, that was deposited at the end of the glacial periods when the river was much larger and covered the entire flood plain. (Howe Test. Day 6 at 30).

27. Generally at Hartford, the top of the Main Sand begins to appear at depths ranging from 19 to 45 feet below ground surface. (Pl. Ex. 203 at EPA_RPT038415). The Main Sand, however, varies in proximity to the surface and in some locations is very close to the surface. (Howe Test. Day 6 at 30-31). The top of the Main Sand varies based on the presence or absence of the overlying clay and silt strata. A finer-grained portion of the Main Sand is referred to as the Main Silt. (Pl. Ex. 203 at EPA_RPT038413).

28. A "structural high" is a location where the Main Sand comes close to the surface. (Howe Test. Day 6 at 34). A significant structural high is present in the central portion of North Hartford, where the B Clay and/or C Clay strata are absent and the upper surface of the Main Silt/Main Sand is overlain only by the A Clay stratum. (Pl. Ex. 194 at EPA_RPT036003). At its apex, the structural high lies as little as six feet below ground surface. (Pl. Ex. 203 at EPA_RPT038414-415; Howe Test. Day 6 at 33-34, 37).

C. Clays at the Site Are Primarily Silty-Clays

29. The Site has a thin veneer of silty-clays on top, below which is about 150

or 200 feet of very coarse grain sand down to a carbonate or limestone bedrock. (Howe Test. Day 6 at 17; Pl. Ex. 196 at EPA_RPT042621). The clay-like strata (sometimes referred to as the A, B, C, and D Clay layers) consist primarily of silty-clays with trace amounts of sand. (Pl. Ex. 203 at EPA_RPT038413; Pl. Ex. 199 at EPA_RPT026166, 247, 253).

30. The upper geological strata at the Site are principally silts or silty-clays and not true clays. (Howe Test. Day 6 at 29; Pl. Ex. 199 at EPA_RPT026166, 247, 253). Most of them range from about 25 to 100 percent silt, which indicates that they would not act as a complete barrier to liquid or gaseous hydrocarbons. (Howe Test. Day 7 at 56). The presence of silts in clay can affect permeability and water would be able to flow through silty-clays. (Sharma Test. Day 14 at 114).

31. Three more permeable units, the North Olive stratum, the Rand stratum, and the EPA stratum, are found within the overlying veneer of silty-clays. (Pl. Ex. 196 at EPA_RPT042621). In the north central portion of Hartford, the North Olive, Rand, and EPA strata merge into the Main Sand. (Pl. Ex. 196 at EPA_RPT042622).

32. Basements of Hartford homes are generally set in the A Clay. (Faryan Test. Day 1 at 209). In certain portions of Hartford, such as in the vicinity of Elm Street and North Delmar Avenue, the Main Sand is in contact with the A Clay, without any intervening geologic strata. (Pl. Ex. 194 at EPA_RPT036003-004). In other portions of Hartford, such as in the vicinity of Birch Street, multiple silty-clay layers exist above the Main Sand, separated by silt layers. (Pl. Ex. 194 at

EPA_RPT036003-004).

33. Clays at the Site can have cracks known as "fractures" and there may be sandy seams within the clay stratum ("permeable lenses") that create preferential pathways for the movement of liquid or gaseous hydrocarbons. (Pl. Ex. 176 at EPA_RPT001874; Faryan Test. Day 1 at 209-210). The extent of fractures in clay strata is frequently difficult to determine to the extreme heterogeneity of geological conditions. (Pl. Ex. 172 at APEXDEPO_001650). It is recognized that many clay layers, once considered to be impermeable, often act as fractured media, containing preferential pathways for liquid hydrocarbon and hydrocarbon vapor migration. (Pl. Ex. 172 at APEXDEPO_001650).

34. Fractures and permeable lenses have been identified in "clay" layers beneath North Hartford. Fractures were observed in the A Clay in the test pits excavated at the Hartford Community Center in 2004. (Pl. Ex. 176 at EPA_RPT001873). Permeable lenses have been found in soil borings into the B Clay at monitoring well location HMW-46B, on the Community Center property. (Pl. Ex. 194 at EPA_RPT042939-40; Pl. Ex. 200 at EPA_RPT041421).

VIII. Petroleum Hydrocarbon Contamination: Four Phases

35. Following their initial release into the environment, petroleum hydrocarbons (also referred to as light non-aqueous phase liquids or "LNAPL") will migrate downward into the subsurface under the force of gravity. (Pl. Ex. 172 at APEXDEPO_001644, 649). After being leaked or spilled in soils, petroleum

hydrocarbons appear in the subsurface in several forms.

36. "Residual-phase hydrocarbons" (i.e. hydrocarbons sorbed to soils) are generated as the mass of petroleum hydrocarbons moves through the subsurface and small portions of the mass are left behind, retained in soil pore spaces. (Pl. Ex. 172 at APEXDEPO_001644, 649). Residual-phase hydrocarbons appear as petroleum-stained soils. (Howe Test. Day 6 at 64) Residual-phase hydrocarbons fill soil pore spaces and by doing so serve to make hydrocarbons from subsequent spills pass through the soil more easily, without likewise getting bound in the soils. (Howe Test. Day 6 at 61). Residual-phase hydrocarbons generate hydrocarbon vapors through volatilization and contaminate groundwater as water comes in contact with or moves through areas of residual-phase contamination. (Howe Test. Day 6 at 61).

37. A hydrocarbon release will continue its movement in the subsurface until its mass is fully depleted through conversion to residual-phase hydrocarbons or it encounters a physical barrier such as the groundwater table, as hydrocarbons are lighter than water, or low permeability geologic strata, such as a clay layer. (Pl. Ex. 172 at APEXDEPO_001644, 649). The effectiveness of the physical barrier in halting movement of the petroleum release depends on the remaining "head" or force behind the release. Pipelines transport petroleum products under significant pressure and releases from pipelines can result in hydrocarbons being forced through low permeability layers and even causing depressions in groundwater. (Howe Test. Day 6 at 61; Pl. Ex. 172 at APEXDEPO_001645, 649).

38. Liquid or "free-phase" hydrocarbons can be found in soils when all of

the absorption sites within the soil are filled or saturated, a condition known as the irreducible saturation. Free-phase hydrocarbons appear like oil floating in water and drip from soil cores pulled from the subsurface. (Howe Test. Day 6 at 62). Upon reaching the groundwater table, petroleum hydrocarbons may move outward laterally, floating as a layer atop the groundwater due to their greater buoyancy. (Howe Test. Day 6 at 27, 61-62; Pl. Ex. 172 at APEXDEPO_001644-45).

39. Dissolved-phase hydrocarbons are constituents of hydrocarbons that dissolve into groundwater or surface water. (Howe Test. Day 6 at 62; Pl. Ex. 172 at APEXDEPO_001651). Among gasoline constituents, benzene is far more water soluble than some of the heavier hydrocarbons and will dissolve more readily into groundwater, as will other lighter hydrocarbons like xylenes. (Howe Test. Day 6 at 62).

40. Vapor-phase hydrocarbons arise from the volatilization of residual-phase and free-phase hydrocarbons. (Howe Test. Day 6 at 62-64; Pl. Ex. 172 at APEXDEPO_001651). The closer the source, generally the higher the concentrations of vapor-phase contaminants in the subsurface gas mixture. (Howe Test. Day 6 at 62-64).

IX. Petroleum Beneath Hartford - Prior Analyses of Apparent Product Thickness

41. Investigative tools available during the Clark/Apex Era were limited in their ability to provide a complete understanding of the site. Early investigations of the Village of Hartford and the Hartford Refinery used wells and soil borings to establish the nature and extent of contamination. (Howe Test. Day 5 at 237-38; Pl. Ex. 168 at EXPRT000182). Geologic data and hydrogeologic information were limited by the low density of wells and the complex and dynamic nature of the hydrogeologic system. (Pl. Ex. 168 at EXPRT000182).

42. Apparent product thickness is the measurement of the vertical thickness of free-phase hydrocarbons floating on water in a well and, until recently, was one of the few methods of determining the extent of hydrocarbons in subsurface soils. (Howe Test. Day 6 at 71-72, 76; Pl. Ex. 172 at APEXDEPO_001655). If there are differences in the surrounding geology, there may be a difference in the apparent product thicknesses at two locations even though the same amount of product is floating on the water table. (Howe Test. Day 6 at 78). In addition, pumping of groundwater can lower the water table and make apparent product thickness look low, when in actuality, the same amount of hydrocarbon would still be present. (Howe Test. Day 6 at 80-81; Pl. Ex. 172 at APEXDEPO_001655).

43. In April 1978, an engineering firm known as John Mathes & Associates ("Mathes") was authorized by Clark Oil (on behalf of Clark Oil, Amoco, and Shell Oil) to investigate the cause of gas odors and fires in Hartford. (Pl. Ex. 18 at

APEXDEPO_001810). Samples collected by Mathes in June and August 1978 indicated the presence of an oval-shaped free-phase hydrocarbon "pool" encompassing an area beneath Hartford, extending from Rand Avenue in the north to the alley south of Watkins Street in the south, and in an east-west direction for the full extent of Elm Street from North Olive Street to North Old Saint Louis Road. (Pl. Ex. 19 at APEXDEPO_002778, 780, 788).

44. Based on an analysis of apparent product thicknesses, Mathes estimated that there were approximately 4 million gallons of free-phase hydrocarbons beneath North Hartford in 1978. (Pl. Ex. 45 at APEXDEPO_002054). Mathes later estimated that the volume had been reduced to 3.2 million gallons of free-phase hydrocarbons by June 1984, due to product recovery efforts. (Pl. Ex. 45 at APEXDEPO_002054).

45. Measurements of apparent product thickness were conducted beneath Hartford in 1978 and from 1990 through 1995. (Pl. Ex. 191 at EPA_RPT022306-355). During these measurements, hydrocarbon thicknesses floating atop the groundwater beneath North Hartford were identified as high as:

Date	Well I.D.	Apparent Product Thickness	Page Citations in Pl. Ex. 191
1978	HB-19A	5.37 feet	EPA_RPT022312
1990	HB-32	5.80 feet	EPA_RPT022316
1991	HMW-08	5.98 feet	EPA_RPT022333
1992	HB-32	3.45 feet	EPA_RPT022317
1993	HB-32	21.96 feet	EPA_RPT022317
1994	HMW-08	8.15 feet	EPA_RPT022334
1995	HMW-16	14.90 feet	EPA_RPT022342

46. Reductions in the extent of apparent product thickness are due in part to free product removal activities undertaken in the area and partly due to the rise in groundwater since the late 1970s, which has smeared significant quantities of hydrocarbons into soil pore spaces, generating greater volumes and concentrations of residual-phase hydrocarbons. (Howe Test. Day 6 at 82-83; Day 7 at 51-52).

47. More recent measurements, in 2005, still showed apparent product thicknesses of more than six feet atop groundwater in multiple areas beneath Hartford. (Def. Ex. 995 at 54, 151, 258, 261).

X. Petroleum Beneath Hartford - Recent ROST Analyses

48. Much more precise information concerning the nature and extent of hydrocarbon contamination beneath the Village of Hartford and the Hartford Refinery has been collected in the last few years. (Pl. Ex. 168 at EXPRT000182). The more recent investigations have utilized modern and innovative tools, including a Rapid Optical Screening Tool ("ROST"), a cone penetrometer ("CPT"), and vapor probes,

while continuing to use traditional wells to measure floating free-phase product. (Howe Test. Day 5 at 238). These tools have allowed collection of information on residual-phase hydrocarbons, not just free-phase product in wells. (Howe Test. Day 5 at 237-238).

49. The CPT/ROST instrument system provides continuous readings on the presence of hydrocarbon contamination as the probe is pushed down into subsurface soils to a depth of 60 feet or more. (Pl. Ex. 168 at EXPRT000183; Howe Test. Day 6 at 17, 23, 28-29).

50. The ROST portion of the instrument system measures the intensity and wavelength of light emitted by fluorescence when petroleum contaminants are irradiated with a laser using a specific wavelength of ultraviolet light. (Pl. Ex. 168 at EXPRT000183; Howe Test. Day 6 at 24-25). Lighter range hydrocarbons, such as gasoline, can be distinguished from heavier hydrocarbons such as diesel or crude oil. Lighter hydrocarbons generally appear as blue fluorescence, heavier hydrocarbons appear as green or yellow, and the heaviest hydrocarbons appear as red fluorescence. (Pl. Ex. 168 at 2 EXPRT000183; Howe Test. Day 6 at 23-25, 27-28).

51. While ROST does not explicitly distinguish between free-phase hydrocarbons and residual-phase hydrocarbons, the relative intensity of fluorescence signals received by the ROST instrument can be used to estimate the general presence or absence of free product in the subsurface hydrocarbon contamination. (Howe Test. Day 6 23-25). ROST cannot detect dissolved-phase or vapor-phase hydrocarbons. (Howe Test. Day 6 at 69).

52. ROST has been used to study extensive portions of the Village of Hartford and the Hartford Refinery. (Howe Test. Day 6 at 14-15; Pl. Ex. 168 at EXPRT000204). In 2004 and 2005, 130 ROST boring locations were selected and completed in the Village on a systematic grid with a spacing of 50 to 100 feet between points. (Howe Test. Day 6 at 16-17; Pl. Ex. 200 at EPA_RPT041413). On the Refinery property 183 ROST boring locations were completed in 2006. (Pl. Ex. 182 at HOWE-000025).

53. ROST analysis has identified current hydrocarbon contamination (free-phase and/or residual-phase) beneath virtually all of Hartford north of East Watkins Street and extending east under the Refinery property. (Howe Test. Day 6 at 83; Pl. Ex. 168 at EXPRT000210; Pl. Ex. 194 at EPA_RPT036012; Pl. Ex. 182 at HOWE-000085). The areal extent of the hydrocarbon plume has remained similar to that observed during the Clark/Apex Era. (Howe Test. Day 5 at 226; Howe Test. Day 6 at 83; Pl. Ex. 168 at EXPRT000189-90).

54. Soils beneath the Hartford Site are contaminated with a complex three-dimensional distribution of different petroleum product types, but gasoline-range and diesel-range hydrocarbons predominate, according to the ROST studies and other confirming studies. (Howe Test. Day 6 at 70-71; Pl. Ex. 168 at EXPRT000188). ROST results from 2004 show that the predominant hydrocarbons detected beneath the Village are light-range hydrocarbons, such as gasoline. A small area in the northern portion of the Village has mainly diesel or No. 2 Fuel Oil contamination. Soils under the eastern edge of the Village are contaminated with some slightly

heavier product types. (Howe Test. Day 6 at 72-73; Pl. Ex. 194 at EPA_RPT036001).

55. The ROST studies have found up to 30-40 feet of total ROST response near the North Terminal Lines and the River Lines as they extend from the Refinery through the Village along North Olive and Elm Streets (meaning that the hydrocarbon contamination extends downward for 30-40 feet beneath those pipeline corridors). (Pl. Ex. 168 at EXPRT000210; Pl. Ex. 194 at EPA_RPT036003-004). One of the areas of greatest total ROST response is near the intersection between Elm Street and North Delmar Avenue, where the structural high in the Main Sand comes closest to the surface. (Howe Test. Day 6 at 71, 74-76; Pl. Ex. 168 at EXPRT000210).

56. Some portions of North Hartford have hydrocarbon contamination less than ten feet below ground surface. (Pl. Ex. 194 at EPA_RPT036004; Pl. Ex. 199 at EPA_RPT026199; Faryan Test. Day 1 at 172-73; Cahnovsky Test. Day 2 at 198.). At many locations in Hartford where hydrocarbon contamination exists, such contamination is first encountered less than 20 feet below ground surface. (Pl. Ex. 195 at EPA_RPT032803; Pl. Ex. 199 at EPA_RPT026199; Faryan Test. Day 1 at 178). A typical basement in Hartford descends to a depth of about eight feet below ground surface. (Faryan Tr. Day 1 at 174-75).

57. Near-surface contamination poses an immediate concern because it generates vapor-phase hydrocarbons in close proximity to residences. (Faryan Test. Day 1 at 174). Deeper contamination also raises concerns because vapors generated at depth can travel through the Main Sand and move upward toward homes. (Faryan Test. Day 1 at 174). Hydrocarbon contamination in the Main Sand also directly

contaminates groundwater that it contacts. (Faryan Test. Day 1 at 174).

XI. Clark Oil / Clark Oil-Apex Pipeline Spills and Leaks in Hartford

58. Numerous spills and leaks of petroleum products from the River Lines and North Terminal Line during the Clark/Apex Era contributed to the subsurface hydrocarbon contamination presently beneath the Village of Hartford. The North Terminal Line and the River Lines were in poor condition, suffering numerous leaks until their eventual abandonment during the Clark Apex Era. (Gustafson Test. Day 7 at 231-32).

59. On October 15, 1974, a leak of No. 2 Fuel Oil occurred from the North Terminal Line, at a location east of North Olive Street and south of Rand Avenue. (Pl. Ex. 4 at APEXDEPO_000977-78). Pools of oil were observed in the roadside ditch, indicating that the fuel oil had surfaced from the buried pipeline, through near-surface soils. (Pl. Ex. 4 at APEXDEPO_000978). Clark Oil personnel noted that the petroleum may have flowed from Rand Avenue and North Olive Street into the Hartford storm sewer at Arbor Street. (Pl. Ex. 4 at APEXDEPO_000978). Oil was observed in the Mississippi River near the outfall from the storm sewer, indicating that the released volume of fuel oil was sufficient enough to travel from Rand Avenue and North Olive Street to the Mississippi River, and requiring Clark Oil to report the leak to the U.S. Environmental Protection Agency ("U.S. EPA") and the Illinois Environmental Protection Agency ("Illinois EPA"). (Pl. Ex. 4 at APEXDEPO_000977-79; Gustafson Test. Day 7 at 189).

60. In 1978, Alan Ludwig was serving as the Hartford Refinery's Manager of Operations and Harold Meicamp was the clerk in the maintenance department responsible for scheduling. (Ludwig Dep. at 12-13, 77-78; Van Petten Depo. at 25-26). In April of that year, Mr. Meicamp provided Mr. Ludwig with a list of "out of plant" pipeline repairs, addressing nine leaks between January 1977 and April 6, 1978. He noted that his records only went back to January 1977. (Pl. Ex. 7 at APEXDEPO_000980; Gustafson Test. Day 7 at 191-92). The list of repairs included the nine leaks described in Paragraph Nos. 61-67, 69 and 70, below.

61. On January 3, 1977, Clark Oil repaired a leak on its black oil line to the Mississippi River (one of the River Lines). (Pl. Ex. 7 at APEXDEPO_000981).

62. On February 22, 1977, Clark Oil initiated repairs on a leak on its gasoline line to the North Terminal / ARCO (the North Terminal Line). (Pl. Ex. 7 at APEXDEPO_000981).

63. On March 1, 1977, Clark Oil initiated repairs on a leak on the gasoline line to the North Terminal / ARCO (the North Terminal Line) at a location south of "Bio Road" -- indicating the Refinery's wastewater treatment plant. (Pl. Ex. 7 at APEXDEPO_000981; Van Petten Depo. at 25).

64. On March 23, 1977, Clark Oil initiated repairs relating to a fuel oil leak from the 3-inch pipeline to the Mississippi River (one of the River Lines). (Pl. Ex. 7 at APEXDEPO_000981).

65. On April 20, 1977, Clark Oil initiated repairs on a leak on the pipeline located at North Olive Street and Rand Avenue (the North Terminal Line). (Pl. Ex.

7 at APEXDEPO_000981).

66. On June 6, 1977, Clark Oil initiated repairs on a leak on the River Lines. (Pl. Ex. 7 at APEXDEPO_000981).

67. On October 28, 1977, Clark Oil initiated repairs on the River Lines' fuel oil line to Tank T-3-1. (Pl. Ex. 7 at APEXDEPO_000981; Gustafson Test. Day 7 at 198). Tank T-3-1 is located near the barge loading facility. (Pl. Ex. 188 at EPA_RPT020280).

68. On March 15, 1978, Clark Oil had a leak of gasoline and butane on the North Terminal Line in the area of Rand Avenue. (Pl. Ex. 13 at APEX_DEPO001953; Pl. Ex. 242 at VHPD000015; Gustafson Test. Day 7 at 201-203). On that date, Clark Oil had utilized the North Terminal Line to receive a shipment of butane from Marathon Pipe Line. (Pl. Ex. 12). The butane had been shipped with gasoline "plugs" on each end, consisting of 55,000 gallons each. (Pl. Ex. 13 at APEX_DEPO001953).

69. On March 19, 1978, Clark Oil again utilized the North Terminal Line to receive a shipment of butane from Marathon Pipe Line. (Pl. Ex. 12). The following day, March 20, 1978, Clark Oil initiated repairs on a gasoline leak in the North Terminal Line, located 30-feet north of Rand Avenue. (Pl. Ex. 7 at APEXDEPO_000981; Pl. Ex. 10 at APEXDEPO_000746; Gustafson Test. Day 8 at 123-124). While the North Terminal Line is a 10-inch pipeline, there was a reducer located at a point north of Rand Avenue which changed the size of the pipeline from 10-inch to 8-inch. (Gustafson Test. Day 8 at 123-124).

70. On April 6, 1978, Clark Oil initiated repairs on a leak on the distillate line to the Mississippi River (one of the River Lines). (Pl. Ex. 7 at APEXDEPO_000981).

71. On April 27, 1978, a leak occurred on the bottom side of the 8-inch gasoline line to the Mississippi River (one of the River Lines), at East Elm Street, approximately 30 feet east of North Delmar Avenue. (Pl. Ex. 242 at VHPD000050, 240-249; Gustafson Test. Day 7 at 206-207). On April 29, 1978, Clark Oil attempted to repair the line with a welded steel patch, but the line failed a pressure test, indicating that it was still leaking. (Pl. Ex. 242 at VHPD000054, 250-252; Gustafson Test. Day 7 at 208).

72. On May 1, 1978, Clark Oil was excavating portions of its pipelines along North Olive Street and pressure testing the lines, indicating that Clark Oil was investigating potential leaks at multiple locations. (Pl. Ex. 242 at VHPD000055, 254-259; Gustafson Test. Day 7 at 208-209). On May 2, Clark Oil announced that it was abandoning the North Terminal Line and that it would be repairing the River Lines. (Pl. Ex. 242 at VHPD000057; Gustafson Test. Day 7 at 209).

73. At noon on May 2, 1978, a leak in a Clark Oil pipeline located on North Olive Street, 20 feet south of East Elm Street, was reported to the Hartford Police Department. (Pl. Ex. 242 at VHPD000059A; Gustafson Test. Day 7 at 210). The Clark Oil North Terminal Line also leaked again at Rand Avenue and North Olive Street. (Pl. Ex. 242 at VHPD000059A)

74. On October 16, 1978, gasoline surfaced near the intersection of North

Olive Street and East Elm Street from a leak in a Clark Oil pipeline. (Pl. Ex. 21 at APEXDEPO_001986). The gasoline pooled in a three-foot hole dug directly above the pipeline and flowed down ditches to the north and south. (Pl. Ex. 21 at APEXDEPO_001986; Pl. Ex. 20). The leak resulted from a faulty valve at the Hartford Refinery, which allowed gasoline to flow into an abandoned Clark Oil pipeline. (Pl. Ex. 20; Gustafson Test. Day 7 at 216).

75. On April 23, 1979, ARCO Pipe Line Company conducted a hydrostatic test of Clark Oil's ten-inch North Terminal Line pipeline running from the Hartford Refinery to the North Terminal (then called the Keller-Piasa Terminal, and later called the Hartford/Wood River Terminal). (Pl. Ex. 26 at APEXDEPO_001847). The test uncovered eight leaks, five of which were old leaks which had been improperly clamped off and three of which were new corrosion pits. (Pl. Ex. 26 at APEXDEPO_001847). Four of the old, improperly clamped pits were located along North Olive Street, south of Rand Avenue. (Pl. Ex. 26 at APEXDEPO_001849). The line was in generally poor condition with large, concentrated corrosion pits. (Pl. Ex. 26 at APEXDEPO_001847).

76. ARCO attributed the condition of the line to the fact that the two North Terminal Lines were bare, lay three inches to five inches apart, and had been subject to no active corrosion management program. (Pl. Ex. 26 at APEXDEPO_001847). The North Terminal Lines lacked cathodic protection, a method of preventing corrosion through electrical means. (Pl. Ex. 130 at SINC000272; Gustafson Test. Day 7 at 237-38).

77. Clark Oil had been shipping 15,000 barrels of product weekly via the North Terminal Line to the North Terminal, but the Terminal found that the shipments were 360 barrels short each week, indicating that the gauges were off at the Refinery or Terminal or that the pipeline had a leak. (Pl. Ex. 96). The North Terminal ultimately stopped taking shipments from Clark Oil's North Terminal Line because the shipments were invariably short. (Pl. Ex. 96).

78. On January 8, 1981, a leak of No. 6 Fuel Oil occurred from the River Lines beneath Elm Street. (Pl. Ex. 34 at APEXDEPO_001989, 991). The product was seen leaching from under the pavement on Elm Street near North Delmar Avenue and entering the sewer. (Pl. Ex. 34 at APEXDEPO_001989, 991; Gustafson Test. Day 7 at 219). Approximately 400 gallons of product reached the Mississippi River. (Pl. Ex. 34 at APEXDEPO_001991). Clark Oil took responsibility for the leak. (Pl. Ex. 34 at APEXDEPO_001991).

79. On April 10, 1981, an oil leak was observed on the corner of East Forest Street and North Olive Street. (Pl. Ex. 37 at APEXDEPO_001992). A pool of oil at the site was described as "growing bigger by the minute." (Pl. Ex. 37 at APEXDEPO_001992). Clark Oil was identified as the offender. (Pl. Ex. 37 at APEXDEPO_001992).

80. On November 10, 1982, a leak of petroleum product, identified by the reporting police officer as "#6 diesel oil, being pumped to the River," was observed running out of the ground near the River Lines on the east side of North Olive Street, near East Forest Street. The spill encompassed an area one-half block long. (Pl. Ex.

39 at APEXDEPO_001993; Gustafson Test. Day 7 at 221-22).

81. On December 31, 1982, a leak of oil was again observed oozing out of the ground in the vicinity of North Olive Street and East Forest Street. (Pl. Ex. 40 at APEXDEPO_001994). Clark Oil-Apex was identified as the offender. (Pl. Ex. 40 at APEXDEPO_001994).

82. On November 20, 1984, No. 2 Fuel Oil surfaced in two locations along East Elm Street and West Elm Street from a leak in the River Lines. The oil was four to five inches deep in some portions of the street. (Pl. Ex. 48 at APEXDEPO_000038; Pl. Ex. 49 at APEXDEPO_004380). Oil on the street was flushed into storm sewers and reached the Mississippi River. (Pl. Ex. 48 at APEXDEPO_000038, 40; Pl. Ex. 49 at APEXDEPO_004382). The leak occurred when Clark Oil-Apex mistakenly pumped fuel oil into a previously abandoned 3-inch pipeline (one of the Original River Lines) when an incorrect connection to the old pipeline was made at the Hartford Refinery. (Pl. Ex. 48 at APEXDEPO_000040).

83. Pipeline leaks also occurred after the Clark/Apex Era, after the Hartford Refinery and its associated pipelines were sold to Premcor in 1988. (Faryan Test. Day 1 at 113-114; Pl. Ex. 188 at EPA_RPT020295-298). Pipeline leaks have also occurred near Hartford on pipelines owned or operated by Shell Oil and ARCO. (Faryan Test. Day 1 at 119; Pl. Ex. 164 at APEX000854).

84. There were no formal leak reporting requirements before 1970. (Gustafson Test. Day 7 at 182). From 1970 until the mid-1980s, the only formal reporting requirements for petroleum spills and leaks were for incidents where the

material reached the navigable waters of the United States. (Gustafson Test. Day 7 at 182). The comparatively large number of reported spills and leaks after the Clark/Apex Era partly reflects more stringent reporting regulations imposed in the later time period. (Faryan Test. Day 1 at 114).

85. The geologic conditions near the pipeline corridors exiting the Hartford Refinery have promoted the accumulation and migration of spilled and leaked hydrocarbons beneath the Village of Hartford, as the pipelines lie along areas where the silty-clays are thin. The portion of the River Lines east of North Olive Street is buried approximately 12 feet below ground surface, and the portion of the River Lines extending beneath Elm Street is buried at a depth of five to six feet below ground surface. (Pl. Ex. 196 at EPA_RPT042646).

86. At the intersection of North Olive Street and East Elm Street, the River Lines lie in the North Olive silt stratum, separated from the Main Sand by only a few feet of silty-clay. (Pl. Ex. 199 at EPA_RPT026242). The portion of the River Lines along Elm Street, although closer to the surface, likewise lies only five feet above the Main Sand at the structural high beneath where Elm Street crosses North Delmar Avenue. (Pl. Ex. 194 at EPA_RPT036003; Howe Test. Day 6 at 92-93).

87. The North Terminal Lines are buried two to four feet deep in the A Clay along North Olive Street, where the A Clay generally extends 5 to 8 feet deep below ground surface. (Pl. Ex. 130 at SINC000272; Pl. Ex. 199 at EPA_RPT026241). The close proximity of the pipelines to permeable strata allowed leaked petroleum product to migrate easily into the Main Sand, where it could accumulate and

maintain its integrity. (Howe Test. Day 5 at 225; Howe Test. Day 6 at 91-92; Pl. Ex. 168 at EXPRT000180, 196-197).

88. The geologic conditions near the pipelines served as a preferential pathway for the downward migration of spilled and leaked hydrocarbons into the Main Sand. Once the hydrocarbons reached the porous Main Sand, they spread out and were able to move significant distances from the original source of the leak or spill. (Howe Test. Day 6 at 92).

89. The pipelines leading from the Hartford Refinery were a major source of the contamination beneath Hartford. The thickest ROST responses at the site are beneath the pipelines and extend out from there. (Pl. Ex. 168 at EXPRT000210). Historic apparent product thicknesses measured in 1978 also indicate higher free-phase product thicknesses along Elm Street, at the corner of East Elm Street and North Olive Street, and along North Olive Street between East Date Street and East Birch Street. (Pl. Ex. 19 at APEXDEPO_002780; Howe Test. Day 6 at 48-49).

90. ROST responses also reflect the specific characteristics of the known pipeline releases during the Clark/Apex Era. For example, as noted above, a leak occurred on the Clark Oil 8-inch gasoline line beneath Elm Street, at a location between North Delmar Avenue and Market Street in April 1978. (Pl. Ex. 242 at VHPD000050, 54; Gustafson Test. Day 7 at 206-207). ROST measurements taken at North Delmar Avenue and Market Street, just north and south of Elm Street, show significant gasoline-range (blue) hydrocarbon responses. (Pl. Ex. 194 at EPA_RPT036003-004). ROST measurements taken on North Olive Street between

Rand Avenue and East Birch Street indicate significant diesel-range (green) hydrocarbon contamination, consistent with Clark Oil's 1974 leak of No. 2 Fuel Oil at that location, as discussed above. (Pl. Ex. 199 at EPA_RPT026242). Likewise Clark Oil's numerous leaks of Six Oil in the early 1980s on North Olive Street and East Forest Street coincide with the heavier range (yellow) hydrocarbon signatures found there. (Pl. Ex. 199 at EPA_RPT026242).

XII. Hartford Refinery Conditions During the Clark/Apex Era

91. Numerous spills and leaks of petroleum products at the Hartford Refinery during the Clark/Apex Era contributed to subsurface hydrocarbon contamination, including contamination of groundwater, beneath the Refinery.

92. In April 1979, Clark Oil authorized Mathes to conduct an investigation of subsurface conditions at the Hartford Refinery. (Pl. Ex. 28 at PRG.DOJ01837; Pl. Ex. 29 at APEXDEPO_000138). In a December 1979 report, Mathes identified extensive hydrocarbon contamination beneath the Refinery, especially near the northeastern corner of the wastewater treatment plant area and near the southwestern portion of the Bulk Storage Tanks North Area. (Pl. Ex. 168 at EXPRT000184, 219; Pl. Ex. 28 at PRG.DOJ01837-43). Soil borings drawn from across a large part of the Refinery were saturated with oil. (Howe Test. Day 5 at 234; Pl. Ex. 28 at PRG.DOJ01840-841).

93. Mathes found in excess of 22 feet of free-phase hydrocarbons (measured as apparent product thickness) floating on top of groundwater at certain Refinery

locations. (Howe Test. Day 5 at 234; Howe Test. Day 6 at 143; Pl. Ex. 28 at PRG.DOJ01846). Mathes concluded that approximately 10 million gallons of hydrocarbon product lay beneath the Refinery in 1979. (Pl. Ex. 28 at PRG.DOJ01841; Pl. Ex. 29 at APEXDEPO_000142).

94. In 1983, Clark Oil-Apex personnel found in excess of 24 feet of hydrocarbons (again measured as apparent product thickness) floating on top of groundwater at certain Refinery locations. (Pl. Ex. 74 at APEXDEPO_002047). Although the two Refinery monitoring points that had shown the greatest apparent product thickness in 1983 were no longer accessible when measurements were next conducted in 1986, other locations indicated in excess of 19 feet of hydrocarbons floating on top of the groundwater beneath the Refinery. (Pl. Ex. 74 at APEXDEPO_002047).

95. Prior to 1980, contaminated material that was removed from the bottoms of product and crude oil storage tanks (called "tank bottoms") was buried adjacent to the tanks on the Refinery property. (Pl. Ex. 32 at APEXDEPO_001022; Howe Test. Day 5 at 235). The estimated volume of leaded tank bottoms from product tanks was 20,000 pounds per year, based on cleaning one 80,000 barrel tank per year. (Pl. Ex. 32 at APEXDEPO_001022). Leaded tank bottoms include tetraethyl lead. (Pl. Ex. 32 at APEXDEPO_001022).

96. On June 12, 1985, oil pockets were observed by an Illinois EPA inspector in six or seven locations in the ditch along Hawthorne Avenue next to the Hartford Refinery. (Pl. Ex. 56). Clark Oil-Apex removed the oil and contaminated

soils and vegetation. (Pl. Ex. 56).

97. In March 1986, C.E. Knipping, a Technical Assistant at the Hartford Refinery with responsibilities relating to environmental management, wrote an internal company memorandum describing a wastewater pond at the Hartford Refinery (called the "guard basin") as "a mess" due to the "ever present oil" that caused "an eye-burning fog" in hot weather. (Pl. Ex. 67 at APEXDEPO_002009; Pl. Ex. 344 at APEXDEPO_000636).

98. In April 1986, a resident whose home bordered the Hartford Refinery complained to Illinois EPA that there were heavy oil stains and contamination in his backyard due to runoff from the Refinery property. (Pl. Ex. 68 at APEXDEPO_002029-30). Clark Oil-Apex trucked in fresh dirt and reseeded the backyard in response to the complaint. (Pl. Ex. 68 at APEXDEPO_002029).

99. In May 1986, oily runoff from the Hartford Refinery reached the Hawthorne Avenue ditch, again contaminating soils and vegetation. (Pl. Ex. 70).

100. In June 1986, Clark Oil-Apex inadvertently vented a vessel containing No. 2 Fuel Oil, spraying a fine mist of fuel oil over North Hartford for approximately 15 minutes. (Pl. Ex. 72). Fuel oil that was released during the incident impacted an area from the Refinery to Route 3 on the western edge of the Village, with oil droplets observed on vegetation and vehicles throughout a 15 square block area in the Village. (Pl. Ex. 72; Pl. Ex. 180;Grant Test. Day 7 at 109-112).

101. In July 1986, storm water runoff escaped the Hartford Refinery and flowed into the Hawthorne Avenue ditch following heavy rains. (Pl. Ex. 75). Clark

Oil-Apex informed Illinois EPA that it would remove any accumulated material found in the ditch. (Pl. Ex. 75).

102. In August 1986, an engineering firm known as Purvin & Gertz evaluated the conditions at the Refinery for a company that was considering buying Clark Oil-Apex. (Pl. Ex. 77 at APEXDEPO_002131, 2134). In performing the analysis, Purvin & Gertz inspected the facility and reviewed information and data provided by Clark Oil-Apex. (Pl. Ex. 77 at APEXDEPO_002134, 2143). Purvin & Gertz concluded that "the maintenance effort was lacking" at the Hartford Refinery and that "[t]oo many pump seals were leaking and there were too many areas which were in need of cleanup." (Pl. Ex. 77 at APEXDEPO_002145).

103. In July 1987, another engineering firm, Arthur D. Little, Inc. ("ADL"), presented a technical assessment of the Clark Oil-Apex refineries to Getty Petroleum Co., because Getty was considering buying those facilities. (Pl. Ex. 81 at APEXDEPO_001706; Gustafson Test. Day 8 at 10).. The technical assessment was generated in part from information provided to ADL by Clark Oil-Apex at a June 1987 meeting in St. Louis and documents subsequently provided by Clark Oil-Apex. (Pl. Ex. 209 at GETTY_000001-002). The assessment identified substantial surface and subsurface oil contamination as a major area of concern regarding the Hartford Refinery. (Pl. Ex. 81 at APEXDEPO_001707, 708, 751, 752).

104. ADL also conducted a site visit to the Refinery where it visually identified "evidence of tank overflows, spills and leaks without cleanup" and stated that the quantity of oil on the ground was "excessive." (Pl. Ex. 81 at APEXDEPO_001750).

Tank dike areas, ditches, unpaved areas, and the guard basin were identified as being heavily contaminated with oil. (Pl. Ex. 81 at APEXDEPO_001767, 768). ADL recommended removing 30,000 cubic yards of contaminated soils. (Pl. Ex. 81 at APEXDEPO_001767; Howe Test. Day 5 at 231).

105. As part of its inquiry, ADL also reviewed a 1986 report on "stock loss" for the Hartford Refinery, which indicated that 1.7% of the total weight of crude oil receive by the Hartford Refinery was lost that year. (Pl. Ex. 81, APEXDEPO_001726; Pl. Ex. 209 at GETTY_000002). Other internal reports prepared by Clark Oil-Apex indicated losses of 1.4% for 1985, 1.9% for 1986, and 1.6% for 1987. (Pl. Ex. 81, APEXDEPO_001726). These figures reflect a material balance analysis comparing closing inventory at the Refinery with opening inventory, adjusted for any shipments received or delivered out of the system. (Gustafson Test. Day 8 at 9).

106. The goal within the refining industry is to have as small a stock loss as possible. (Gustafson Test. Day 8 at 9). ADL found that the stock loss at the Hartford Refinery greatly exceeded its 1.0% benchmark for "below average performance" for a typical refinery in the late 1980s. (Pl. Ex. 81, APEXDEPO_001725). The engineering firm identified "significant oil leaks at the . . . refinery" as a potential source of part of the high stock loss. (Pl. Ex. 81, APEXDEPO_001725).

107. In November 1987, inspectors from U.S. EPA and Illinois EPA visited the Hartford Refinery and identified soils that were severely saturated with oil around two large tanks near the western end of the facility, which were designated as Tank 10-6 and Tank R-16. (Grant Test. Day 7 at 115-122; Pl. Ex. 141 at IEPA001048-49;

Pl. Ex. 299; Pl. Ex. 84 at APEXDEPO_005832, 834, 835, 837). Soil samples collected in the vicinity of Tank 10-6 and Tank R-16 were characterized as being collected from soil "saturated with oil." (Pl. Ex. 84 at APEXDEPO_005839-840).

108. In February 1989, an Illinois EPA inspector observed significant oil contamination within the earthen berm surrounding another tank at the Refinery, which was designated Tank 10-2. (Grant Test. Day 7 at 123-124; Pl. Ex. 141 at IEPA001052-53; Pl. Ex. 89 at APEXDEPO_005871, 874). By that time, Tank 10-2 was approximately 50 years old. (Pl. Ex. 89 at APEXDEPO_005874). Although Premcor had recently purchased the Refinery, the Illinois EPA inspector characterized the soil contamination around Tank 10-2 as "years of accumulation of waste drippage and spillage" based on the combined accumulation of wet recent contamination and older cracked and dried oil contamination. (Grant Test. Day 7 at 124-28; Pl. Ex. 89 at APEXDEPO_005874).

109. Premcor determined that closure of Tank 10-2 was necessary to comply with newly-promulgated State regulations applicable to tanks like Tank 10-2 that were used for storage of certain oily materials that were classified as hazardous wastes. (Grant Test. Day 7 at 123-128; Pl. Ex. 92 at APEXDEPO_005883). Premcor removed the tank and its contents and excavated and disposed of 409 tons of the most grossly-contaminated soil from within the earthen berm for Tank 10-2. (Grant Test. Day 7 at 128-31; Pl. Ex. 92 at APEXDEPO_005883). The remaining soil contamination within the berm area was left in place and treated with microbes. (Grant Test. Day 7 at 131-132; Pl. Ex. 92 at APEXDEPO_005883).

110. Before it was removed, Tank 10-2 was located on the western side of the Refinery property, near the facility's wastewater treatment area. (Grant Test. Day 7 at 132-133; Pl. Ex. 188 at EPA_RPT020285). In apparent product thickness testing conducted in 1979, approximately ten feet of free-phase hydrocarbons had been identified below Tank 10-2. (Pl. Ex. 168 at EXPRT000219; Pl. Ex. 188 at EPA_RPT020285).

111. ROST analyses recently conducted on the Refinery property showed a mixture of products in subsurface soils, including gasoline, diesel, and what appeared to be asphalts or heavier products. The observed pattern of contamination at the Refinery is typical of an area where there have been many releases of different kinds of hydrocarbon products, and where the lighter-range product contamination has migrated away and left the less mobile products. (Howe Test. Day 6 at 74).

112. The areas of thickest hydrocarbon contamination beneath the Refinery (combined free-phase and residual-phase contamination as identified by ROST) include the area near the pipeline terminus for the Refinery's River Lines and North Terminal Lines (which is near the wastewater treatment area) and the main Refinery process areas. (Howe Test. Day 6 at 71, 74-76; Pl. Ex. 168 at EXPRT000210).

XIII. Free-Phase Hydrocarbons Have Migrated From the Refinery to the Village

113. As set forth in detail below, during the Clark/Apex Era, petroleum hydrocarbons migrated from the Hartford Refinery to the Village of Hartford in the

following manner:

- Hydrocarbons which had accumulated due to leaks and spills at the Refinery migrated deep into the Main Sand beneath the Refinery due to low groundwater levels in the 1960s and early 1970s. (Howe Test. Day 6 at 104, 107-108).

- A "structural high" in the Main Sand acted as a ramp running from the Refinery toward the middle of the Village of Hartford. (Howe Test. Day 6 at 113).

- Prior leaks and spills filled soil pore spaces in a corridor of the Main Sand between the Refinery and the Village and formed a preferential pathway for migration of other liquid hydrocarbons, which are often called light non-aqueous phase liquids ("LNAPL"). (Howe Test. Day 5 at 224-25; Howe Test Day 6 at 102, 105).

- As water levels rose beginning in the late 1970s, the rising water forced the hydrocarbon materials up along the preferential pathway from beneath the Refinery to beneath the Village. (Howe Test. Day 6 at 109-110).

- The hydrocarbon movement along the preferential pathway was enhanced by localized groundwater flow toward the Village. (Howe Test. Day 6 at 109).

A. Significant Hydrocarbon Contamination Existed In the Main Sand Beneath the Hartford Refinery in the 1970s.

114. Significant quantities of petroleum products were spilled or leaked into the subsurface when Clark Oil owned the Refinery. As noted above, a 1979 investigation conducted for Clark Oil determined that approximately 10 million gallons of petroleum products were present beneath the Hartford Refinery at that time. (<u>See</u> Section XII, above).

115. Groundwater levels were low from the mid-1960s through the mid-1970s due to drought-like conditions in the Hartford area. (Howe Test. Day 5 at 225;

Pl. Ex. 168 at EXPRT000197, 209). Hydrocarbon leaks generally follow the pull of gravity, descending into the subsurface until they make contact with the water table and spread outward, because hydrocarbons are lighter than water. (Howe Test. Day 5 at 225). Thus, when water levels are low, hydrocarbons will penetrate deeper below the surface than when groundwater levels are higher. (Pl. Ex. 168 at EXPRT000197).

116. Recent ROST studies of hydrocarbon contamination beneath the Refinery show hydrocarbons as deep as 40 to 50 feet below ground surface, consistent with groundwater levels during the early portion of the Clark/Apex Era, and 8 to 12 feet below current groundwater levels. (Howe Test. Day 5 at 255; Howe Test. Day 6 at 103-104; Pl. Ex. 168 at EXPRT000212).

B. There is a Structural High in the Main Sand Beneath North Hartford

117. Silts and clays at the site thin at a structural high, where more permeable sands come closer to the surface. (Howe Test. Day 6 at 43-44). Structural highs are significant because they are areas where hydrocarbons tend to accumulate. (Howe Test. Day 6 at 109). Rising groundwater levels will move hydrocarbons from areas where less permeable layers extend further below the ground surface, up into the more permeable structural high, where the hydrocarbons will pool and persist for a long period of time. Hydrocarbons naturally migrate upward into structural high spots because they are less dense (or more buoyant) than water. (Howe Test. Day 6 at 33, 43-44).

118. A structural high in the Hartford area generally extends from beneath

the Refinery's wastewater treatment area to the central portion of the Village, reaching its apex in the vicinity of Elm Street and North Delmar Avenue, where it rises to within approximately 12 feet of the ground surface. (Howe Test. Day 6 at 40; Pl. Ex. 225 at EPA_PRT018024).

C. A Corridor with Higher Relative LNAPL Conductivity Has Facilitated the Migration of Hydrocarbons from Beneath the Refinery to the Village

119. LNAPL saturation of pore spaces in soils permits the freer flow of hydrocarbons through the soils. LNAPL conductivity is a measure of hydrocarbons' ability to move through the subsurface. (Howe Test. Day 6 at 108; Pl. Ex. 168 at EXPRT000195; Pl. Ex. 203 at EPA_RPT038420). Studies done at the Site identified a corridor of high LNAPL conductivity extending from the vicinity of the Refinery's wastewater treatment area northwest to Elm Street. (Howe Test. Day 6 at 108; Pl. Ex. 168 at EXPRT000211; Pl. Ex. 203 at EPA_RPT038511). The corridor from the Refinery's wastewater treatment plant area northwest to Elm Street in the Village still had the highest apparent product thicknesses at the Site in 2005. (Pl. Ex. 185 at HOWE000011; Def. Ex. 995 at 132-35, 151 (Figures 2-52, 2-53, 2-54, 2-55, 5-1)).

120. The existence of that corridor of high LNAPL conductivity also is reflected in the extraordinary high LNAPL removal and recharge rates that were observed during LNAPL recovery pilot testing that was done at the principal recovery well in the area (well HMW-44C, which is located beneath North Olive Street, between East Forest and East Elm Streets). (Pl. Ex. 203 at EPA_RPT038403; Pl. Ex. 204 at EPA_RPT010707-0023, 707-0299, 707-0308).

D. Rising Groundwater Levels Forced Hydrocarbons Along the Preferential Pathway from the Refinery to the Village.

121. Groundwater levels at the Site rose significantly from about 1977 through 1987. (Pl. Ex. 168 at EXPRT000188, 213). As groundwater levels rose, free-phase hydrocarbons preferentially migrated along the structural high in the Main Sand toward the Village, rather than into the less permeable B/C Clay. (Pl. Ex. 168 at EXPRT000188). Hydrocarbon migration along the structural high was facilitated by the presence of a high LNAPL conductivity corridor in that area, due to prior pipeline leaks. (Pl. Ex. 168 at EXPRT000211). Through this mechanism, a portion of the millions of gallons of free-phase hydrocarbons present beneath the Refinery in the 1970s migrated to beneath the Village of Hartford.

E. Hydrocarbon Movement Along the Preferential Pathway was Enhanced by Localized Groundwater Flow Toward the Village

122. Groundwater flow generally has limited influence on the movement of free-phase hydrocarbons at rest on top of the water table (although it does transport contaminants that are dissolved into the groundwater itself – i.e., dissolved-phase hydrocarbons). (Howe Test. Day 7 at 61-62). Even so, groundwater flow would have augmented the effect of rising groundwater on the movement of free-phase hydrocarbons up the structural high and through the highly-permeable and porous Main Sand toward the Village. (Howe Test. Day 6 at 113).

123. The groundwater beneath the Hartford Refinery would naturally flow to the west, toward the Mississippi River. (Pl. Ex. 183 at HOWE001186; Sharma Test.

Day 14 at 99-100, 116; Pl. Ex. 200 at EPA_RPT041360-361). That natural groundwater flow has been altered by industrial groundwater pumping at several industrial facilities in the area, including at the Hartford Refinery itself and at the Shell Oil/ConocoPhillips Refinery and the former Amoco Refinery. (Pl. Ex. 183 at HOWE001186, 1198-99; Turner Test. Day 10 at 37; Sharma Test. Day 14 at 98-99; Pl. Ex. 200 at EPA_RPT041360-361, 41385, 41400).

124. As recently as 2004, the groundwater in the Main Sand beneath the western portion of the Refinery sometimes flowed to the northwest, toward the Village, though the flow in the area is subject to seasonal fluctuations. (Def. Ex. 995 at 92 (Figure 2-12); Sharma Test. Day 15 at 13-15). Even when groundwater beneath other parts of the Refinery was flowing in an easterly direction, there was often localized flow in a westerly direction from the Refinery's wastewater treatment area toward the Village. (Pl. Ex. 191 at EPA_RPT022262-64). A report that was prepared for Premcor and several other companies in early 2004 attributed that localized westerly flow to "an apparent mounding effect . . . in the northwest corner of the Premcor facility." (Pl. Ex. 191 at EPA_RPT022231).

125. A groundwater mound is a localized high groundwater elevation, similar to a hill in the water level. (Howe Test. Day 6 at 46; Sharma Test. Day 15 at 8-9).

126. Earlier studies of groundwater elevations in the Main Sand also identified a groundwater mound near the Refinery's wastewater treatment area. (Pl. Ex. 168 at EXPRT000214 (Figure 13, prepared from Pl. Ex. 28 at PRG.DOJ01846), EXPRT000215 (Figure 14, derived from Pl. Ex. 164 at APEX000847)).

127. The groundwater mound in that area may have been due to the presence of finer grained sediments there, causing the water to be "wicked up," much as a thin straw placed in a glass of water causes water to rise within the straw above its normal level. (Howe Test. Day 6 at 45-46, 177-180; Howe Test. Day 7 at 61).

128. While the geologic preconditions for a groundwater mound are naturally occurring, the groundwater mound at the western end of the Refinery was likely enhanced through leakage of water from the Refinery's wastewater treatment plant into the subsurface. (Howe Test., Day 6 at 45-46, 177-180; Howe Test. Day 7 at 61). Clark Oil built the wastewater treatment plant on the Refinery grounds in 1973, adding a large fire water pond in the mid-1980s. The wastewater treatment plant's tanks processed millions of gallons of wastewater and leakage of water into the subsurface would be expected. The bottoms of these tanks were replaced in 1993, indicating prior leakage beneath the wastewater treatment area. (Howe Test. Day 6 at 110-11; Pl. Ex. 168 at EXPRT000198).

129. Leakage is also indicated in a geological cross-section of the wastewater treatment area, which shows the near-surface North Olive stratum saturated with water. (Pl. Ex. 182 at HOWE-000066). The North Olive stratum is not typically saturated in this area and is above the regional groundwater table, suggesting that some source of water was infiltrating the area. (Howe Test. Day 6 at 112).

130. The groundwater elevation maps that have been prepared since early 2005 no longer show a groundwater mound near the Refinery's wastewater treatment area. (Def. Ex. 995 at 98-101 (Figures 2-18 to 2-21); Pl. Ex. 182 at HOWE-000057).

That may be due to a recent increase in groundwater pumping at the Hartford Refinery. (Howe Test. Day 7 at 5-6, 61). For example, in the fall of 2004, Premcor rehabilitated and restarted an old groundwater production well near the western edge of the Refinery property, and sent water that was pumped from that well to the Refinery's wastewater treatment plant. That was done as part of a Western Property Boundary Gradient Control Plan that Premcor put in place to try to limit migration of groundwater contamination from the Refinery property toward the Village and its public water supply wells. (Pl. Ex. 183 at HOWE001182, 1197).

131. Years before that, in February 1986, the environmental manager for Clark Oil-Apex wrote an internal company memorandum recommending installation of an enhanced pumping system to establish a cone of depression in the groundwater and thereby assure that hydrocarbons would not migrate beyond the Refinery boundaries. (Pl. Ex. 65). It does not appear that Clark Oil-Apex adopted that recommendation, and it was not until late 2004 and early 2005 that Premcor implemented a groundwater control program to try to limit migration of hydrocarbon contamination from the Refinery property. (Pl. Ex. 183 at HOWE001202; Pl. Ex. 168 at EXPRT000185).

132. The recent pumping activity at the western end of the Refinery property has artificially lowered groundwater levels in the immediate area, which appears to have eliminated any current sign of a groundwater mound and reversed the localized westerly flow of groundwater in the Main Sand that was observed in that area until 2005. (Howe Test. Day 7 at 5-6, 61; Pl. Ex. 168 at EXPRT000187; Pl. Ex. 182 at

HOWE-000057). Even so, the groundwater studies at the Hartford Site are ongoing, and one of the most recent reports on the subject recommended "continued groundwater monitoring to verify the understanding of groundwater flow and the dissolved-phase plume." (Pl. Ex. 200 at EPA_RPT041355).

XIV. Clark Oil / Clark Oil-Apex Product Recovery Efforts

133. On July 31, 1978, Clark Oil installed and began operating a hydrocarbon product recovery well that was installed next to a service station near the intersection of North Delmar Avenue and West Forest Street (Recovery Well No. 1) (Pl. Ex. 23; Pl. Ex 358 at EPA_RPT035917). A second recovery well was installed on a lot at North Olive Street and East Date Street (Recovery Well No. 2) and it began operating in March 1979. (Pl. Ex. 23; Pl. Ex. 358 at EPA_RPT035917).

134. The recovery wells utilized low volume skimmer pumps which removed free-phase hydrocarbons from the surface of the groundwater and pumped them into a storage tank. (Pl. Ex. 111 at PRG.DOJ07194). The tanks would be inspected and when full a vacuum truck would be sent from the Refinery to collect the material. (Knipping Dep. at 60-61). The material was returned to the refining process and became a saleable product for Clark Oil. (Knipping Dep. at 61).

135. On April 16, 1983, the Hartford Police observed the tank located at Recovery Well No. 2 overflowing and leaking liquid hydrocarbons onto the ground. (Pl. Ex. 41 at APEXDEPO_000787).

136. On September 26, 1987, the Hartford Police observed the tank located

at Recovery Well No. 2 overflowing and leaking gasoline onto the ground. (Pl. Ex. 82).

137. On July 5, 1988, the tank located at Recovery Well No. 2 overflowed and leaked gasoline onto the ground. (Pl. Ex. 85).

138. In 1986, Mr. Knipping, Clark Oil-Apex's environmental manager, prepared an internal company memorandum discussing a proposed hydrocarbon recovery well for the Hartford Refinery property, which stated that a new recovery well "would pay for itself in a hurry and generate a considerable amount of revenue in the future." (Pl. Ex. 65). The recovery wells located in the Village likewise generated a profit for Clark Oil-Apex. (Novelly Dep. at 35-36).

XV. Forensic Analyses of Free-Phase Hydrocarbons Beneath Hartford

139. Forensic analyses conducted on free-phase hydrocarbon samples collected from beneath Hartford have consistently indicated that Clark Oil was a major contributor to the contamination, as indicated by the "fingerprint" of the alkylation process used in producing the product and the amount and type of organic lead additives found in the samples. (Pl. Ex. 24 at APEXDEPO_002065; Pl. Ex. 27 at APEX_US0000266; Pl. Ex. 167 at APEXDEPO_001054).

A. Background

1) Lead Additives

140. Organic lead gasoline additives were used beginning in the 1920s as "anti-knocking" agents to reduce noisy combustion in automobile engines. (Pl. Ex. 167 at APEXDEPO_001041).

141. The Hartford Refinery used tetraethyl lead (TEL) exclusively as the organic lead additive in its leaded gasoline during the Clark/Apex Era. (Nicholson Test. Day 8 at 208; Pl. Ex. 167 at APEXDEPO_001037, 38, 43).

142. The Shell Oil Refinery used a different organic lead additive – commonly called a mixed lead package – during at least portions of the period between 1960 and 1980. (Nicholson Test. Day 8 at 218; Pl. Ex. 229 at PRG.DOJ03925-926). The mixed lead package used by Shell Oil in 1978 contained tetramethyl lead (TML), trimethyl ethyl lead (TMEL), dimethyl diethyl lead (DMDL), methyl triethyl lead (MTEL), and a small amount of tetraethyl lead. (Nicholson Test. Day 9 at 155-56; Def. Ex. 242 Part 2 at 55-56; Def. Ex. 931).

143. The Amoco Refinery also used a mixed lead package as its additive for leaded gasoline during at least portions of the period between 1960 and 1980. (Nicholson Test. Day 8 at 218; Pl. Ex. 229 at PRG.DOJ03925-926).

144. Chemical analysis of leaded gasoline samples can be used to determine the type of lead additive contained in the gasoline. (Pl. Ex. 167 at APEXDEPO_001040-41, 43).

2) Total Lead Content

145. During the 1960s, leaded gasoline generally contained from 1.5 to 3.5 grams of lead per gallon. (Nicholson Test. Day 8 at 204). In the 1970s, lead levels ranged from 1.5 to 2.0 grams per gallon in leaded gasoline, or a little higher. (Nicholson Test. Day 8 at 204). In late 1979, new regulations limited the total lead composition of gasoline produced by refineries. (Nicholson Test. Day 8 at 203-204).

In the 1980s lead levels were generally below 0.7 grams per gallon, dropping below 0.3 grams per gallon after 1986. (Nicholson Test. Day 8 at 204).

146. Lead in free-phase hydrocarbons tends to be conserved in the product at concentrations similar to those existing at the time it was released into the environment. (Nicholson Test. Day 8 at 207). The amount of total lead in a gasoline sample can therefore be used to help determine when the gasoline was produced. (Pl. Ex. 167 at APEXDEPO_001041, 43).

3) Alkylation Methods

147. Alkylate is added to gasoline to increase octane. (Nicholson Test. Day 8 at 213). Alkylate can made using either hydrofluoric acid or sulfuric acid as a catalyst. (Nicholson Test. Day 8 at 213). The two methods require different facilities and there are technical differences in the two production processes. (Nicholson Test. Day 9 at 16).

148. The Hartford Refinery utilized a hydrofluoric alkylation process to enhance octane in gasoline it produced . (Pl. Ex. 27 at APEX_US000266; Pl. Ex. 81 at APEXDEPO_001711). The alkylation unit was built in 1969. (Pl. Ex. 78 at GETTY000107; Pl. Ex. 81 at APEXDEPO_001712). In the 1970s, gasoline refined by Clark Oil at the Hartford Refinery contained approximately 17% alkylate. (Pl. Ex. 230 at PRG.DOJ03988).

149. The Shell Oil Refinery and the Amoco Refinery both used a different alkylation method that utilized sulfuric acid as a catalyst. (Nicholson Test. Day 8 at 214-215; Pl. Ex. 27 at APEX_US000266; Def. Ex. 931).

150. The hydrofluoric acid alkylation process and the sulfuric acid alkylation process generate differing amounts of four trimethylpentane compounds in the alkylate. The ratios between those different trimethylpentane compounds can be used to determine the alkylation process that was used to make the alkylate in a formulated gasoline sample. (Nicholson Test. Day 8 at 213; Nicholson Test. Day 9 at 16; Pl. Ex. 167 at APEXDEPO_001039-40, 43-44).

B. Prior Forensic Analyses

151. In 1978, Clark Oil requested that DuPont characterize a petroleum hydrocarbon sample collected from beneath Hartford and investigate the lead-containing anti-knock compound present in the sample. (Pl. Ex. 14 at APEXDEPO_002058). DuPont concluded that the sample consisted of a regular grade gasoline containing tetraethyl lead (TEL). (Pl. Ex. 14 at APEXDEPO_002059).

152. In February 1979, the Illinois EPA analyzed 13 hydrocarbons samples collected from beneath Hartford and product samples from Clark Oil, Amoco, and Shell Oil to determine the organic lead or organic lead packages present in the samples. (Pl. Ex. 229 at PRG.DOJ03925-26). Clark Oil's leaded gasoline contained only tetraethyl lead (TEL), while Amoco's and Shell Oil's leaded gasolines contained a mixed alkyl lead package (abbreviated "TMX"). (Pl. Ex. 229 at PRG.DOJ03925-926). Each of the 13 Hartford samples contained TEL and none contained TMX. (Pl. Ex. 229, PRG.DOJ03925-26).

153. In January 1979, Clark Oil retained Professor Lyle Albright of Purdue University to determine the alkylation process used in refining hydrocarbon samples

collected from beneath Hartford. (Pl. Ex. 228 at PRG.DOJ03980; Pl. Ex. 24 at APEXDEPO_002065). Clark Oil provided Professor Albright with chromatography results for two product samples collected from beneath Hartford, 10 gas chromatographs from Clark Oil's gasoline blending stocks, and five gas chromatographs reflecting different finished gasolines produced Clark Oil and Shell. (Pl. Ex. 228 at PRG.DOJ03980; Pl. Ex. 230 at PRG.DOJ03988; Pl. Ex. 232 at PRG.DOJ04024).

154. To determine the alkylation process used, Professor Albright identified separate ranges of trimethylpentane ratios that would be found in alkylate prepared with an hydrofluoric acid catalyst and alkylate prepared with a sulfuric acid catalyst and he analyzed the Hartford samples and compared it to those reference standards. (Nicholson Test. Day 9 at 19). In March 1979, Professor Albright informed Clark Oil that the sample contained predominantly, if not exclusively, alkylate prepared with a hydrofluoric acid catalyst. (Pl. Ex. 24 at APEXDEPO_002065; Nicholson Test. Day 8 at 232).

155. Clark Oil's Laboratory Manager was M.C. Engelman. (Pl. Ex. 344 at APEXDEPO_000636). In a July 26, 1979 memorandum, Mr. Engelman reported the results of his own analysis of hydrocarbons that had been recovered from wells beneath Hartford. (Pl. Ex. 27 at APEX_US0000266). He determined that the samples contained tetraethyl lead and fluoride (indicative of Clark Oil's hydrofluoric acid alkylation process). Remarking at the flouride results in particular, the scientist observed "of course, this confirms Clark to be the guilty party." His memorandum

concluded that "our work indicates that the hydrocarbon accumulation under Hartford, Illinois originated from Clark Oil as well as Shell and/or Amoco Oil." (Pl. Ex. 27 at APEX_US0000266).

156. In November 1990, the Illinois EPA issued a report entitled *Hartford Underground Hydrocarbon Investigation*. (Pl. Ex. 111). Illinois EPA concluded that the hydrocarbon contamination then present beneath Hartford had been leaked from pipelines associated with the Hartford Refinery during the Clark/Apex Era, due to the chemical composition of the hydrocarbon material and the hydro geology of the area. (Pl. Ex. 111 at PRG.DOJ07188). Illinois EPA also concluded that a December 1989 pipeline leak on Shell Oil's Rand Avenue pipeline and leaks from the North Terminal Line during Sinclair Marketing's period of ownership had contributed to contamination in areas bordering Hartford. (Pl. Ex. 111 at PRG.DOJ07188).

157. Illinois EPA's investigation found that samples of the hydrocarbons beneath Hartford consisted of leaded regular gasoline, with tetraethyl lead as the primary lead additive component. (Pl. Ex. 111 at PRG.DOJ07190). The Shell and Sinclair Marketing leaks had consisted of unleaded gasoline, which was inconsistent with the lead findings in the samples. (Pl. Ex. 111 at PRG.DOJ07190). Illinois EPA also analyzed the alkylate fraction of the leaded gasoline samples and determined that it was consistent with the hydrofluoric acid process used at the Hartford Refinery and inconsistent with the sulfuric acid process used by Shell. (Pl. Ex. 111 at PRG.DOJ07190).

158. In 2005, gas chromatography analysis of samples indicated that, at the

vast majority of sampling locations, the hydrocarbons beneath Hartford consist of 90% or more gasoline-range material, with the remainder being diesel-range material. (Pl. Ex. 199 at EPA_RPT026170, 194; Faryan Test. Day 1 at 185-86). Almost all sampling locations other than those near North Olive Street or north of Birch Street contained 100% gasoline-range material. (Pl. Ex. 199 at EPA_RPT026194). Only in the northernmost portions of Hartford does the hydrocarbon consist of 30% or greater diesel-range material. (Pl. Ex. 199 at EPA_RPT026194). Near-surface samples collected in the northeast corner of Hartford consisted of 70-99% diesel-range material. (Pl. Ex. 199 at EPA_RPT026194).

C. Recent Forensic Analyses

159. A separate analysis that was performed by one of the United States' experts, Dr. Andrew Nicholson, reconfirmed much of the prior analysis, based on a new study of free-phase hydocarbons that were collected beneath Hartford in 2003 and 2005 (the "Nicholson Samples"). First, Dr. Nicholson concluded that the contamination consisted primarily of leaded gasoline. (Nicholson Test. Day 8 at 193). Second, he determined that total lead concentrations in the Nicholson Samples were similar to the concentrations of lead in gasoline that Clark Oil produced between 1967 and 1980. (Nicholson Test. Day 8 at 194). Third, he found that the samples contained mainly tetraethyl lead, which was the only type of lead additive used by Clark Oil and Clark Oil-Apex. (Nicholson Test. Day 8 at 194; Pl. Ex. 167 at APEXDEPO_001037, 38, 43). Finally, he discovered that most of the samples contained trimethylpentane compounds in ratios that corresponded to alkylate

produced with a hydrofluoric (HF) alkylation process. (Nicholson Test. Day 8 at 194-95).

160. Gas chromatograms of the Nicholson Samples indicated that most of the samples were leaded gasoline. (Nicholson Test. Day 8 at 241; Pl. Ex. 167 at APEXDEPO_001067). Some samples also appeared to contain some diesel-range material (such as samples taken from well RW-2, near the intersection of North Olive and East Cherry Streets, and well HMW-48C on North Olive Street, between East Birch and Rand Avenue). (Nicholson Test. Day 8 at 243-245; Nicholson Test. Day 9 at 92; Pl. Ex. 167 at APEXDEPO_001065, 1068-69).

161. Dr. Nicholson also used data from gas chromatography to categorize hydrocarbon mixtures into paraffins, isoparaffins, aromatics, napthenes, and olefins (which is called "PIANO analysis"). (Nicholson Test. Day 9 at 3). Formulated gasoline is generally enriched in isoparaffins and aromatics. (Nicholson Test. Day 9 at 3). PIANO analyses conducted on the Nicholson Samples showed that the samples were dominated by isoparaffins and aromatics, and they were therefore consistent with formulated gasoline. (Nicholson Test. Day 9 at 4, 7; Pl. Ex. 167 at APEXDEPO_001070). The Nicholson Samples also were shown to be consistent with formulated leaded gasoline through a comparison with a leaded gasoline reference standard. (Nicholson Test. Day 9 at 4-5; Pl. Ex. 167 at APEXDEPO_001070).

162. Dr. Nicholson analyzed the total lead content of the samples to date the sources of the contamination. Total lead found in the Nicholson Samples was consistent with a pre-1980 gasoline because it exceeded 0.7 grams per gallon, with

almost of all of the samples collected from within the Village having 0.9 grams of lead per gallon or more. (Nicholson Test. Day 9 at 8, 10). As noted above, lead levels were generally below 0.7 grams per gallon in the 1980s, dropping below 0.3 grams per gallon after 1986. (Nicholson Test. Day 8 at 204). From January 1976 through October 1979, the total lead per gallon of gasoline produced by Clark Oil at the Hartford Refinery, on a monthly basis, ranged between 2.599 and 1.088 grams per gallon. (Pl. Ex. 167 at APEXDEPO_001071; Pl. Ex. 226; Pl. Ex. 227 at PRG.DOJ03883-84). From November 1979 through December 1981, total lead per gallon of gasoline ranged between 1.014 and 0.057 grams per gallon. (Pl. Ex. 167 at APEXDEPO_001071; Pl. Ex. 226).

163. The type of lead contained in the Nicholson Samples also matched the lead that was added to gasoline produced at the Hartford Refinery during the Clark/Apex Era. Tetraethyl lead was the only lead additive for gasoline used through about 1960, when the industry developed other lead additive packages that contained mostly methyl lead compounds. (Nicholson Test. Day 8 at 206, 218). The Hartford Refinery used tetraethyl lead exclusively in its leaded gasoline during the Clark/Apex Era. (Nicholson Test. Day 8 at 208; Pl. Ex. 167 at APEXDEPO_001037, 38, 43; Pl. Ex. 226; Pl. Ex. 227 at PRG.DOJ03883-84; Pl. Ex. 229 at PRG.DOJ03925-926). Amoco and Shell Oil used mixed lead packages during at least portions of the period between 1960 and 1980. (Nicholson Test. Day 8 at 218; Pl. Ex. 229 at PRG.DOJ03925-926). The Nicholson Samples were dominated by tetraethyl lead and did not contain elevated levels of other lead compounds that would be found in

mixed lead packages. (Nicholson Test. Day 9 at 8, 13; Pl. Ex. 167 at APEXDEPO_001037, 38, 43).[3]

164. Dr. Nicholson's analysis of trimethylpentane ratios in the Nicholson Samples showed that much of the contamination was formulated gasoline made with a hydrofluoric acid alkylation process. (Pl. Ex. 167 at APEXDEPO_001039-040, 043-044).

165. When Professor Albright's trimethylpentane ratio methodology was

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[3] The Court has been advised that in reviewing the transcript of Dr. Nicholson's trial testimony, the United States discovered that the stenographer mis-transcribed some of the chemical names and key terms that Dr. Nicholson used in his live testimony. In at least some instances, that mis-transcription could lead to a fundamental misunderstanding of the expert opinions that Dr. Nicholson actually expressed at trial. Most notably, the stenographic transcript uses the chemical name "tetra<u>methyl</u> lead" at multiple points when Dr. Nicholson actually used the term "tetra<u>ethyl</u> lead." For example, the transcript uses the wrong chemical name when it says Dr. Nicholson testified that "Shell and Amoco used lead packages and Clark/Apex used exclusively ***tetramethyl*** lead" (Nicholson Test. Day 9 at 8 (emphasis added)), although Dr. Nicholson's expert report and the historical documentary evidence both confirm that Clark Oil and Clark Oil-Apex used tetraethyl lead. (Pl. Ex. 1678 at APEXDEPO_001037, 38, 43; Pl. Ex. 229 at PRG.DOJ03925-926; Pl. Ex. 27 at APEX_US0000266). The transcript also uses the wrong chemical name at points when Dr. Nicholson meant to emphasize – and did actually say at trial – that tetraethyl lead was the predominant in type of lead in the samples from the Site (and that tetraethyl lead was found in more than 90% of those samples). <u>See</u>, <u>e.g.</u>, Nicholson Test. Day 9 at 8 (incorrectly reads "lead expatiation was dominated by tetra<u>methyl</u> lead" when it should say "lead speciation was dominated by tetra<u>ethyl</u> lead"); Nicholson Test. Day 9 at 10 (incorrectly reads "We know from the lead expatiation results that all of the samples are dominated by tetra<u>methyl</u> lead, therefore, it is entirely consistent with this material being produced by Clark Apex prior to 1980"); Nicholson Test. Day 9 at 11 (incorrectly reads "the other refineries did only use tetra<u>methyl</u> lead after 1980"); Nicholson Test. Day 9 at 12 (incorrectly reads"their only being tetra<u>methyl</u> lead in those samples"); Nicholson Test. Day 9 at 13 (incorrectly reads "We found that very consistently, over 90 percent of the lead in all samples was associated with tetra<u>methyl</u> lead" and "we also know that Clark used, Clark /Apex used, only tetra <u>methyl</u> lead"). <u>But see</u> Nicholson Test. Day 9 at 13 (correctly reads "Tetramethyl lead is not detected in almost all wells."). The Court agrees that the stenographer mis-transcribed some of the chemical names and key terms and adopts the United States' corrections.

applied the Nicholson Samples, the vast majority of the samples fell within the range of expected values for product made with a hydrofluoric acid process, one or two were within the range typical of a sulfuric acid process, and a few fell in an indeterminate range between the two. (Nicholson Test. Day 9 at 21). Similar results were obtained using two other comparable trimethylpentane ratio comparison methodologies. (Nicholson Test. Day 9 at 22-25).

166. Over three-fourths of the Nicholson Samples collected from the Village of Hartford were consistent with Clark Oil gasoline based on total lead content, type of organic lead additive, and alkylation process, and were inconsistent with Shell Oil or Amoco gasolines due to the different alkylation process used at those facilities. (Nicholson Test. Day 9 at 25, 27).

167. Well HMW-48 is located on North Olive Street, south of Rand Avenue, and it is one of the few locations which contained a primarily non-gasoline petroleum product. (Nicholson Test. Day 9 at 86; Pl. Ex. 167 at APEXDEPO_001066). Samples collected at well HMW-48 had a total lead concentration of 0.26 grams per gallon. (Nicholson Test. Day 9 at 86). The chromatogram for HMW-48 indicates that only the free-phase contamination in that area contains a mixture of a smaller amount of gasoline with a larger amount of weathered fuel oil. (Nicholson Test. Day 9 at 87, 91-92, 153-54). In 1974, Clark Oil had a leak of No. 2 Fuel Oil from its pipeline located along North Olive Street, south of Rand Avenue. (Pl. Ex. 4 at APEXDEPO_00978).

XVI. Soil Vapor Data

168. In 2004, dozens of permanent vapor monitoring points were installed at the Site to collect soil vapor data at different depths (very shallow, shallow, medium, and deep) in order to sample vapors in different geological strata beneath a given sampling location. (Faryan Test. Day 1 at 208; Pl. Ex. 176 at EPA_RPT001898; Pl. Ex. 177 at EPA_RPT001331,1333-334). In 2004 and 2005, soil vapor sampling was conducted at those newly-installed locations and at other previously-installed sampling points, as part of a set of comprehensive soil vapor investigations. In many of those sampling locations, extremely high levels of benzene, isopentane, and other vapor-phase hydrocarbon constituents were found at all depths. (Pl. Ex. 176 at EPA_RPT001905-909, 927-934; Pl. Ex. 177 at EPA_RPT001372-379).

169. Soil vapor samples collected in the A Clay at vapor monitoring point VMP-15VS in September 2004 contained benzene at 500,000 parts per billion by volume ("ppbv"), which equates to approximately 1,610,000 micrograms per cubic meter ("$\mu g/m^3$") for benzene. (Pl. Ex. 176 at EPA_RPT001905; Faryan Test. Day 1 at 211; Watters Test. Day 4 at 18-19). VMP-15VS is located on North Olive Street, north of East Forest Street. (Pl. Ex. 176 at EPA_RPT001905). As indicated above, numerous pipeline leaks occurred from Clark Oil pipelines located beneath North Olive Street between East Forest and East Elm Streets during the Clark/Apex Era.

170. High levels of benzene are present in soil vapor in the A Clay (the uppermost soil layer at the site). In August 2004, soil vapor samples collected in the A Clay near the Hartford Community Center at VMP-24M contained 55,000 ppbv

benzene (approximately 177,000 $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001905). Soil vapor samples collected in the A Clay at MP-60A (in the alley between East Forest and East Watkins Streets, west of North Olive Street) in August 2004 contained 6,100 ppbv benzene (approximately 20,000 $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001905). Soil vapor samples collected in the A Clay at VMP-28S (on West Birch Street, near North Delmar Avenue) in August 2004 contained 2,100 ppbv benzene (approximately 6,800 $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001905).

171. High benzene concentrations also are present in the North Olive stratum (the silt layer lying beneath the A Clay at the northern part of the Village). Soil vapor samples collected in the North Olive stratum at VMP-15S (on North Olive Street, north of East Forest Street) in September 2004 contained 1.4 million ppbv benzene (approximately 4.5 million $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001906). Soil vapor samples collected in the North Olive stratum at MP-55A (East Elm Street at North Olive Street) in August 2004 contained 350,000 ppbv benzene (approximately 1.1 million $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001906). Soil vapor samples collected in the North Olive stratum at VMP-6S (on the Hartford Community Center property) in August 2004 contained 300,000 ppbv benzene (approximately 1.0 million $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001906). Soil vapor samples collected in the North Olive stratum at MP-47A (East Date Street at North Olive Street) in August 2004 contained 36,000 ppbv benzene (approximately 116,000 $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001906). Soil vapor samples collected in the North Olive stratum at MP-48A (in the alley between West Date and West Elm Streets, ½ block west of North

Delmar Avenue) in August 2004 contained 34,000 ppbv benzene (approximately 110,000 $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001906).

172. Finally, there are very high benzene levels in vapors in the Main Sand stratum. Soil vapor samples collected in the Main Sand at MP-55C (East Elm Street at North Olive Street) in August 2004 contained 1.9 million ppbv benzene (approximately 6.1 million $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001908). Soil vapor samples collected in the Main Sand at MP-52C (North Delmar Avenue at Elm Street) in August 2004 contained 870,000 ppbv benzene (approximately 2.8 million $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001908). Soil vapor samples collected in the Main Sand at VMP-6D (on the Hartford Community Center property) in August 2004 contained 300,000 ppbv benzene (approximately 970,000 $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001908). Soil vapor samples collected in the Main Sand at MP-48B (alley between West Date and West Elm Streets, ½ block west of North Delmar Avenue) in August 2004 contained 890,000 ppbv benzene (approximately 3.1 million $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001908). Soil vapor samples collected in the Main Sand at VMP-26D (East Watkins Street near North Market Street) in August 2004 contained 60,000 ppbv benzene (approximately 190,000 $\mu g/m^3$). (Pl. Ex. 176 at EPA_RPT001906).

XVII. Vapor Intrusion Mechanics

173. Migration of vapor-phase hydrocarbons from the subsurface to indoor air is governed by properties that are known as advection and diffusion. (Pl. Ex. 176

at EPA_RPT001873). Advection is the tendency of a gas to migrate toward an area of lower pressure. Advection is typically the more dominant vapor migration mechanism near the receptor (such as a building foundation wall). (Pl. Ex. 176 at EPA_RPT001873). Diffusion is the tendency of a gas to migrate away from an area of higher gas concentration. Diffusion is the more dominant migration mechanism nearer the source of the hydrocarbon contamination. (Pl. Ex. 176 at EPA_RPT001873). The influence of these mechanisms is dependant upon soil type, source concentration, and building characteristics. (Pl. Ex. 176 at EPA_RPT001873; Watters Test. Day 4 at 30-31). Seasonal effects, including the presence of a frost layer and variations in soil moisture content, water table elevation, barometric pressure, and biodegredation rate can also affect the rate of vapor migration. (Pl. Ex. 176 at EPA_RPT001873).

174. Vapors will tend to migrate along paths of least resistance. (Pl. Ex. 176 at EPA_RPT001873). When utility lines and pipelines are buried, the area around them is frequently backfilled with a fill material (sand, gravel, etc.) that is more permeable than the surrounding silty-clay. (Faryan Test. Day 1 at 177; Pl. Ex. 172 at APEXDEPO_001651). Utility and pipeline corridors can serve as preferential pathways for the movement of hydrocarbon vapors directly to homes. (Faryan Test. Day 1 at 176-77; Pl. Ex. 165 at EXPRT000149). Numerous utility and pipeline corridors exist throughout North Hartford. (Pl. Ex. 195 at EPA_REP032802).

175. Vapor migration can also occur in comparatively low permeability soils (such as silty-clays) through secondary permeability features, such as fractures or

sandy seems in clay-like soils. (Pl. Ex. 176 at EPA_RPT001873).

176. Precipitation can "seal" the surface of the ground by filling soil pore spaces with water, resulting in a preferential pathway beneath homes' basements where moisture has not yet saturated the soil. (Dondanville Test. Day 2 at 168).

177. Subsurface vapors can enter homes through exposed soil (such as dirt floors in basements or crawl spaces), cracks in basement walls or floors, basement floor drains or sumps, or unsealed areas around utility lines and connections. (Cahnovsky Test. Day 3 at 93-95; Weis Test. Day 4 at 172-74; Faryan Test. Day 1 at 97-98; Faryan Test. Day 2 at 9). Using handheld monitoring equipment, emergency response personnel have detected concentrated hydrocarbon vapors entering Hartford homes through cracks in basement walls and floors. (Cahnovsky Test. Day 3 at 112, 114; Pl. Ex. 107 at APEXDEPO_003252; Pl. Ex. 378 at IEPA001162-64). In another case, a U.S. EPA responder could hear vapors hissing as they came into the basement of a building through cracks around a pipe. (Faryan Test. Day 1 at 216; Faryan Test. Day 2 at 116-117, 131).

178. Soil vapors can be pulled into homes by negative interior pressure. Homes often develop negative pressure due to temperature difference, the operation of heating, ventilating, and/or air conditioning appliances, or other equipment such as fans or clothes dryers. (Pl. Ex. 165 at EXPRT000149).

179. Isopentane is a significant constituent of vapor-phase hydrocarbons and, due to its presence in high concentrations, it has been used as an indicator for assessing vapor-phase hydrocarbon levels in soils at the Site and for assessing

hydrocarbon vapor migration and vapor intrusion into homes. (Faryan Test. Day 1 at 210; Pl. Ex. 176 at EPA_RPT001879). The distribution of other gasoline constituents – such as benzene and hexane – is similar to the distribution of isopentane vapors at the Site, but isopentane normally is present at much higher concentrations. (Pl. Ex 177 at EPA_RPT001352-58; Def. Ex 598).

XVIII. Hydrocarbon Vapor Inhalation Health Concerns

180. Inhalation of petroleum hydrocarbon vapors, including benzene, can result in respiratory irritation, headaches, dizziness, lightheadness, nausea, deadening of the nerves, increased likelihood of abnormal heart rhythms (arrhythmias) and impacts on blood cell production. (Watters Test. Day 4 at 32; Pl. Ex. 247 at ATSDR000552-53; Guzelian Test. Day 15 at 116-18). Benzene is the main health driver at the Hartford Site because it is generally the contaminant that shows the most serious health effects at the lowest concentrations. (Faryan Test. Day 1 at 210).

181. Exposure to benzene has been associated with development of cancer, especially acute myeloid leukemia. (Pl. Ex. 247 at ATSDR000553; Guzelian Test. Day 15 at 116-18). Benzene is one of only a few chemicals that has been classified as a "Class A - Known Human Carcinogen" because it has been proven to cause cancer in human beings. (Weis Test. Day 4 at 179).

182. In addition to containing benzene, vapor-phase hydrocarbons contain additional chemicals, such as toluene and xylene, which may target the same

biological systems as benzene and have similar effects and therefore contribute to the health hazard. (Watters Test. Day 4 at 61). Hexane can cause nerve damage known as "peripheral neuropathy," which includes numbness, muscle weakness, and eventual paralysis at high concentrations. (Pl. Ex. 260 at ATSDR000989-990).

183. The Agency for Toxic Substances and Disease Registry ("ATSDR") is a sister agency of the Centers for Disease Control that mainly addresses public health issues associated with exposure at sites with environmental contamination. (Watters Test. Day 4 at 6).

184. Toxicological Profiles are chemical-specific reports generated by ATSDR that, among other things, review all available research literature, identify potential health effects, and establish health-based Minimal Risk Levels ("MRLs") for exposures to the chemical. (Watters Test. Day 4 at 10; Pl. Ex. 247 at ATSDR000540-542). Toxicological Profiles are subjected to review by ATSDR committees on different topic areas (such as health effects, MRLs, etc.), as well as external peer reviewers. (Watters Test. Day 4 at 12-13; Pl. Ex. 247 at ATSDR000536-538).

185. A Minimal Risk Level is the value for human exposure that is believed not to result in a harmful effect on a person, for a particular exposure route (inhalation, ingestion, etc.) and length of exposure (acute, intermediate, or chronic exposure). (Watters Test. Day 4 at 15). MRLs only address non-cancer end-points and do not measure cancer risk. (Watters Test. Day 4 at 23). ATSDR uses the term "acute exposure" for exposures of 14 days or less; "intermediate exposure" for 15 to 364 days; and "chronic exposure" for exposures of a year or more. (Watters Test.

Day 4 at 18). ATSDR's acute inhalation MRL for benzene is 9 ppb (which equates to approximately 29-30 $\mu g/m^3$), the intermediate inhalation MRL for benzene is 6 ppb (approximately 20 $\mu g/m^3$), and chronic inhalation MRL for benzene is 3 ppb (approximately 10 $\mu g/m^3$). (Watters Test. Day 4 at 18-20; Pl. Ex. 247 at ATSDR000932-44).

186. Minimal Risk Levels have been used by the federal and state agencies at Hartford as the basis for some of the Comparison Values that are used in assessing potential health risks posed by vapor intrusion and in determining the effectiveness of interim measures to limit vapor intrusion into individual homes. (Watters Test. Day 4 at 22).

XIX. Hydrocarbon Odor Complaints

187. Since 1966, there have been hundreds of hydrocarbon vapor odor complaints that Hartford residents have registered with the local, state, and/or federal agencies. (Pl. Ex. 191 at EPA_RPT022281-290; Pl. Ex. 242 at VHPD000004-007). Complaints have been made by occupants of at least 161 separate homes, businesses, and places of worship, located throughout North Hartford. (Faryan Test. Day 1 at 162, 212; Pl. Ex. 176 at EPA_RPT001896, 917-919; Pl. Ex. 191 at EPA_RPT022281-290).

188. In making complaints to government agencies, residents have commonly identified health-related problems that are associated with exposure to benzene and other volatile hydrocarbons, such as headaches, nausea, and burning of the eyes, throat, and lining of the nose. (Guzelian Test. Day 15 at 116-17; Guzelian

Test. Day 16 at 150-155; Def. Ex. 101 at 1; Def. Ex. 102 at 25, 29, 54; Def. Ex. 213 at 1; Def. Ex. 617 at 24; Pl. Ex. 312 at APEXDEPO_005106; Pl. Ex. 321 at APEXDEPO_001308; Pl. Ex. 363 at IEPA001086).

189. Hartford residents who have had concerns about hydrocarbon-related health impacts have been referred to medical clinics. (Watters Test. Day 4 at 88). That included a child born with a congenital heart defect who was referred to the Pediatric Environmental Health Speciality Unit to assess concerns regarding sensitization to chemicals found in vapor-phase hydrocarbons and their potential impact on the child. (Watters Test. Day 4 at 88).

XX. Hydrocarbon-Related Fires

190. Hydrocarbon-related fires occur when vapor-phase hydrocarbons move into a home, build up to a level where they can become explosive, and are then ignited by an ignition source, such as a pilot light on a furnace or hot water heater. (Faryan Test. Day 1 at 119; Weis Test. Day 4 at 190, 194-95, 208; Pl. Ex. 165 at EXPRT000148, 50-53). Numerous hydrocarbon-related fires occurred in Hartford from 1970 through 1990. (Pl. Ex. 164 at APEX000855; Pl. Ex. 191 at EPA_RPT022291).

191. Firefighters and other emergency response personnel often quantify the risk of explosion or fire due to hydrocarbon gases using combustible gas measurements that are expressed as a percentage of the "lower explosive limit" (or "LEL") . The lower explosive limit is the level at which combustible gases in the

atmosphere will ignite or explode (if there is oxygen and an ignition source). Gases exceeding 100% LEL remain combustible until the gases become so concentrated that they reach the "upper explosive limit" (or "UEL"), where the absence of oxygen no longer supports combustion. Because there is uncertainty associated with LEL measurements – in particular the significant variations in hydrocarbon gas concentrations that may be found within an enclosed area – emergency response personnel normally use a measurement of 10% LEL as a benchmark for evacuating an enclosed area, to ensure a margin of safety. (Weis Test. Day 4 at 158-159; Cahnovsky Test. Day 4 at 87, 106-08).

192. On April 23, 1970, a fire occurred on 112 East Cherry Street. (Pl. Ex. 1 at APEXDEPO_004317; Pl. Ex. 3 at APEXDEPO_004325; Pl. Ex. 242 at VHPD000180). The front window of the home was blown out by the initial explosion, along with blocks from the foundation. (Pl. Ex. 1 at APEXDEPO_004317). When the Police arrived a fire was burning in the vicinity of the furnace. (Pl. Ex. 242 at VHPD000180). A very strong odor of gas was noted. (Pl. Ex. 242 at VHPD000180).

193. On March 13, 1973, a fire occurred in the basement of 119 West Date Street, with fire burning on the wall, six-inches off the floor. (Pl. Ex. 2 at APEXDEPO_004323; Pl. Ex. 242 at VHPD000006). The following day, the Fire Department again checked the basement and obtained a 100% LEL reading on the explosion meter. (Pl. Ex. 242 at VHPD000006). On March 15, 1973, the Fire Department again measured explosive gases in the basement, despite a fan having been left on in the basement over-night in an effort to ventilate. (Pl. Ex. 242 at

VHPD000006-007).

194. On April 11, 1974, a fire occurred at 119 East Date Street. (Pl. Ex. 191 at EPA_RPT022291).

195. On April 28, 1975, a fire occurred at 119 East Watkins Street in the basement, by the sewer opening. (Pl. Ex. 242 at VHPD000007, 200; Pl. Ex. 164 at APEX000855). The sewer opening was tested both that day and the next and indicated 100% LEL. (Pl. Ex. 242 at VHPD000007). The sewer opening was covered with plastic, which eliminated the fumes from the sewer. The residents, however, again contacted the Fire Department later in the afternoon of April 29 due to strong gas odors. On this visit, the Fire Department found a small hole in the basement wall that was allowing vapors to enter the home. (Pl. Ex. 242 at VHPD000007).

196. On March 24, 1978, a small fire occurred in the basement of 119 West Birch Street along cracks in the basement wall in the area of the sewer drain, which was put out by a neighbor. (Pl. Ex. 11 at APEXDEPO_004331; Pl. Ex. 242 at VHPD000014). When the police arrived, the home smelled highly of gasoline. (Pl. Ex. 242 at VHPD000014). The residents were advised to ventilate the home. (Pl. Ex. 242 at VHPD000014).

197. On March 25, 1978, a small fire occurred in the basement laundry room of 118 East Date Street when vapors ignited off the hot water heater's pilot light and then ignited a cardboard box full of rags. (Pl. Ex. 11 at APEXDEPO_004332; Pl. Ex. 242 at VHPD000014). The resident put the fire out himself and was advised by the Police Department and Fire Department to ventilate the basement. (Pl. Ex. 242 at

VHPD000014).

198. On March 27, 1978, a fire occurred in the basement of 117 West Birch Street, causing extensive damage to the basement and kitchen. (Pl. Ex. 11 at APEXDEPO_004333-334; Pl. Ex. 242 at VHPD000015). The kitchen area was completely engulfed in flames and the Fire Department required about 30 minutes to extinguish the blaze. (Pl. Ex. 242 at VHPD000015).

199. On March 30, 1978, a fire occurred in the basement of 105 West Cherry Street. (Pl. Ex. 11 at APEXDEPO_004335; Pl. Ex. 242 at VHPD000017). The Fire Department contained the fire to the basement and damage was limited to furniture and clothes which had been stored in the basement. (Pl. Ex. 242 at VHPD000017).

200. On March 31, 1978, a fire occurred in the basement wall of 118 East Date Street, causing damage to basement paneling. (Pl. Ex. 11 at APEXDEPO_004336; Pl. Ex. 242 at VHPD000017). The house smelled highly of gasoline. (Pl. Ex. 242 at VHPD000017).

201. On April 11, 1979, five fires occurred in Hartford at the following locations: 119 East Date Street, 116 East Watkins Street, 123 East Watkins Street, 130 East Watkins Street, and 409 North Olive Street. (Pl. Ex. 25 at APEXDEPO_004338).

202. On March 6, 1981, an explosion occurred in the sewer beneath the intersection of West Birch Street and North Old St. Louis Road. The force of the explosion had displaced the manhole cover. (Pl. Ex. 224 at APEX000307). Flames were observed coming out of the manhole. (Pl. Ex. 224 at APEX000307). The

resident at 125 West Birch Street advised the responding Police Officer that her house smelled like gas and a 20% LEL reading registered in her basement. (Pl. Ex. 224 at APEX000307-308). The responding fireman reported that the basement floor at 121 W. Birch Street had "blown up around the sewer plug approximately 12 ft." and the police made a similar report. (Pl. Ex. 224 at APEX000309-310). The sewer plug at 123 West Birch Street had also "blown out." (Pl. Ex. 224 at APEX000309).

203. On July 28, 1981, a basement fire occurred at 102 East Cherry Street, when vapors ignited off the pilot light of the hot water heater. (Pl. Ex. 35 at APEXDEPO_004339).

204. On June 11, 1985, a basement fire occurred at 501 North Olive Street when vapors infiltrated the basement and were ignited by a pilot light. (Pl. Ex. 50; Pl. Ex. 135).

205. On March 21, 1990, a fire occurred in the basement of 102 East Cherry Street. (Pl. Ex. 98; Pl. Ex. 140 at AR00386). An origin and cause investigation determined that gasoline like vapors had entered through the basement foundation and were ignited by the water heater, resulting in fire damage to the residence. (Pl. Ex. 140 at AR00386). In the days preceding the fire, the homeowners had noticed very strong odors coming from the basement which burned their eyes. (Pl. Ex. 140 at AR00388). They had attempted to ventilate the basement with fans and by opening the windows, but after ventilation was complete the vapors would return. (Pl. Ex. 140 at AR00388). Monitoring well B-16, located in the backyard of the residence, had been monitored on March 16, 1990 and contained 1.9 feet of

hydrocarbons floating on top of the groundwater on that date. (Pl. Ex. 104 at APEXDEPO_004492).

206. On May 14, 1990, a fire occurred in the basement of 101 East Birch Street. (Pl. Ex. 102).

207. On May 16, 1990, a fire occurred in the basement of 117 East Forest Street following extremely heavy rains. (Pl. Ex. 99 at APEXDEPO_004355-56). Flames were observed along the wall of the basement. (Pl. Ex. 99 at APEXDEPO_004355). The hot water heater was identified as the ignition source of the vapors. (Pl. Ex. 100). Two weeks earlier, on April 27, 1990, explosion meter readings had been conducted in response to an odor complaint. (Pl. Ex. 158). Measurements of 48% LEL, 128% LEL, and 90% LEL were measured at different points along the basement wall. (Pl. Ex. 158). The police officer conducting the testing complained of getting a headache while present. (Pl. Ex. 158).

208. The Illinois Department of Public Health was contacted and, on May 10, 1990, sampled the basement air. (Pl. Ex. 105 at APEXDEPO_003250). Noting very strong petroleum odors, IDPH measured responses above background in several areas of the basement and cracks in the floor were identified as contributing to increased readings. (Pl. Ex. 107 at APEXDEPO_003252). The air sampling found benzene in the air at levels up to 12.16 ppb benzene (approximately 39 $\mu g/m^3$). (Pl. Ex. 105 at APEXDEPO_003250; Pl. Ex. 107 at APEXDEPO_003252). Laboratory analysis noted benzene among other hydrocarbons, but was unable to quantify the benzene in one of the samples due to the instrument having been saturated by the

sample. (Pl. Ex. 107 at APEXDEPO_003255).

209. On May 16, 1990, a fire occurred in the basement of 119 West Birch Street and clothes were set on fire along the east wall. (Pl. Ex. 101 at APEXDEPO_004358-59).

210. On May 19, 1990, a Hartford Police Officer identified brown marks on his basement wall and burns in the basement rug indicating that he had apparently had a basement fire at his home at 117 East Forest Street. (Pl. Ex. 103).

211. On May 20, 1990, the Hartford Fire Department responded to a fire at 101 East Birch Street. (Def. Ex. 167). Thick smoke was present in the basement and it was suspected that the fire was due to ignition of "sewer gas." (Def. Ex. 167).

XXI. Recognition of the Relationship between Groundwater / River Stage and Vapor Intrusion Events

212. Groundwater levels in the Main Sand below Hartford rise and fall with the level of the Mississippi River, and the water levels vary seasonally. (Howe Test. Day 6 at 39).

213. In March 1973, an Amoco Refinery engineer was quoted in an Alton Telegraph article noting that vapor intrusion events normally accompanied higher river stages, which suggested that water pressure may be pushing pockets of gas to the surface. (Pl. Ex. 3 at APEXDEPO_004326).

214. As early as April 1978, an official with the Illinois State Water Survey noted that basement fires seemed to be related to the Mississippi River and that

every time the River had a high stage the basement fires started occurring. (Pl. Ex. 13 at APEXDEPO_001953).

215. In a July 1978 report that was prepared for Clark Oil, Amoco, and Shell Oil, the Mathes engineering firm graphed odor complaints against groundwater levels and emphasized that odor complaints usually occurred after periods of heavy rain or when the level of the Mississippi River was rising. (Def. Ex. 242 Part 1 at 7, 28-29; Def. Ex. 242 Part 2 at 5). Mathes. concluded that the upward movement of the groundwater level appeared closely correlated to reports of gas odors. (Def. Ex. 242 Part 1 at 29).

216. A March 1992 report prepared by Engineering-Science, Inc. ("ESI") for Shell updated the analysis conducted by Mathes and likewise concluded that fluctuation of groundwater elevations is a primary factor controlling hydrocarbon gas emanations from the subsurface. (Pl. Ex. 164 at APEX000808). ESI identified that during a period of severe drought from 1987 through 1989, no hydrocarbon-related fires occurred and few odor complaints were reported. (Pl. Ex. 164 at APEX000808, 852-853). When normal rainfall levels returned in February 1990, with subsequent aquifer recharge and rising groundwater levels, odor complaints and hydrocarbon-related fires increased in North Hartford. Specifically, four house fires occurred during the second week of April 1990 following a 5-inch rain and fires in mid-May 1990 occurred after a period of very heavy rain. (Pl. Ex. 164 at APEX000808).

217. A January 2004 report prepared by a Clayton Group Services, Inc. for U.S. EPA review and approval, the *Investigation Plan to Determine Extent of Free*

and Dissolved Phase Hydrocarbons, likewise concluded that the pattern of rising groundwater and surface water elevations and increased house fires and hydrocarbon odor complaints/observations indicated that fluctuation of groundwater and surface water elevations was one of the primary factors controlling hydrocarbon vapor emanation from the subsurface beneath Hartford. (Pl. Ex. 191 at EPA_RPT022204).

218. In September 2006, ENSR prepared a memorandum entitled *Time Series Analysis and Statistical Evaluation of the Effects of Meteorological Phenomena on the Incidence of Reported Vapor Events*. (Pl. Ex. 250 at EPA_RPT035114-199). The study included a number of time-series analyses of different data sets, including precipitation, barometric pressure, subsurface pressure, and Mississippi River stage, reported vapor events, and periods where multiple reported vapor complaints occurred within a few days ("vapor event clusters"). (Pl. Ex. 250 at EPA_RPT035116).

219. ENSR recognized that the significant natural variation in the meteorological data and the comparative scarcity of vapor event reports made it unreasonable to expect to identify statistically strong correlations from the data, but concluded that correlation coefficients of 0.2 to 0.5 would be indicative of a strong degree of correlation. (Pl. Ex. 250 at EPA_RPT035123). ENSR found that over the long-term, Mississippi River stage and prior-day precipitation correlate best with reported vapor events and that clusters of vapor event reports correlate most strongly to elevated River stage. (Pl. Ex. 250 at EPA_RPT035123).

XXII. May 2002 East Watkins Street Event

220. In mid-May 2002, a series of vapor intrusion incidents along East Watkins Street affected several families, including the Ellis family at 134 East Watkins, the Williamson family at 130 East Watkins, the Harvey family at 126 East Watkins, the Zager family at 122 East Watkins, the Bedwell family at 120 East Watkins, and the Phillips family at 116 East Watkins.

221. On May 13, 2002, a public health professional with the Illinois Department of Public Health received a telephone message from one of the residents of 134 East Watkins, which indicated that she and her family had been awakened in the middle of the night by strong odors and had left their home. (Dondanville Test. Day 2 at 153; Def. Ex. 16). Premcor representatives visited the home between noon and 1:00 p.m. and measured gases at 3% of the lower explosive limit. (Dondanville Test. Day 2 at 153; Def. Ex. 16; Pl. Ex. 116 at APEXDEPO001291). The home was being ventilated. (Pl. Ex. 115 at APEXDEPO_002479).

222. After first contacting the Illinois EPA Emergency Response Unit in Collinsville, Illinois, the IDPH employee returned the homeowner's call and made an appointment to meet the resident at her house at 3:00 p.m. to place air sampling devices in the home. (Dondanville Test. Day 2 at 153-54; Def. Ex. 16).

223. At 2:15 p.m. on May 13, 2002, the Hartford Fire Department received an alarm relating to an odor complaint at 116 East Watkins. The resident reported that he had odors in his home for the past three to four days and had been

ventilating his house. (Pl. Ex. 115 at APEXDEPO_002479, 482). The Fire Department responded quickly, but about an hour passed before they took their first explosivity readings in that home. At 3:15 p.m., the Fire Department found gases at 6% of the lower explosive limit in the basement at 116 East Watkins. (Pl. Ex. 115 at APEXDEPO_002479, 482).

224. Emergency response personnel from the Hartford Fire Department and Illinois EPA were already in the neighborhood when the IDPH employee arrived to collect indoor air samples at 134 East Watkins. (Dondanville Test. Day 2 at 155; Def. Ex. 16). The homeowner let the IDPH employee into her house to place the air sampling devices. (Dondanville Test. Day 2 at 155). The IDPH employee avoided spending much time in the home, due to the evident hydrocarbon odors. (Dondanville Test. Day 2 at 155-156).

225. An Illinois EPA employee placed another air sampling canister in the home at 130 East Watkins, because the family who lived there also had children. (Dondanville Test. Day 2 at 156-58; Def. Ex. 16; Pl. Ex. 116 at APEXDEPO001292).

226. Beginning at 3:40 p.m., the Fire Department began screening the following homes for explosivity and vapors: 134 East Watkins, 130 East Watkins, 120 East Watkins, 122 East Watkins, and 126 East Watkins. (Pl. Ex. 115 at APEXDEPO_002479). No other elevated LEL readings were found during that screening.

227. The Fire Department and Illinois EPA advised residents to turn off their pilot lights to reduce the possibility of vapors igniting and to ventilate their homes to

try to dissipate the fumes. (Pl. Ex. 115 at APEXDEPO_002478; Dondanville Test. Day 2 at 157). A resident of 120 East Watkins told the Fire Department that he had odors in his home for the past four days and had already been ventilating his home. (Pl. Ex. 115 at APEXDEPO_002479). A resident of 126 East Watkins said that he had odors in his home the night before, but that they were no longer present. (Pl. Ex. 115 at APEXDEPO_002479).

228. Some residents had difficulty ventilating their homes because their basement windows did not open. (Dondanville Test. Day 2 at 173; Pl. Ex. 321 at APEXDEPO_001308). Other residents were concerned about compromising home security by leaving windows open for ventilation, but they also were concerned about lost wages if they stayed home. (Dondanville Test. Day 2 at 173; Pl. Ex. 321 at APEXDEPO_001308).

229. The IDPH employee took steps to obtain additional air sampling equipment and made arrangements to sample two more homes (116 East Watkins and 120 East Watkins) in addition to the homes that were already being sampled (130 East Watkins and 134 East Watkins). (Dondanville Test. Day 2 at 158). Samples from the four homes were delivered to Springfield, where the Illinois EPA laboratory initially had difficulty analyzing them due to the extremely high total hydrocarbon concentrations. (Dondanville Test. Day 2 at 161).

230. On Saturday, May 25, 2002 – over the Memorial Day weekend – the IDPH employee received a call at home from an Illinois EPA employee who had received the sampling results from May 13-14. (Dondanville Test. Day 2 at 163).

That holiday weekend call to her home was made because the results reflected very high hydrocarbon concentrations, and there was a need to inform the residents without delay. (Dondanville Test. Day 2 at 163-164).

231. Sampling results showed 330 ppb benzene (approximately 1,062 $\mu g/m^3$) at 130 East Watkins and 269 ppb benzene (approximately 866 $\mu g/m^3$) at 134 East Watkins, based on 24-hour samples collected from May 13 to 14, 2002. (Dondanville Test. Day 2 at 176; Pl. Ex. 321 at APEXDEPO_001312). Samples collected the next day, May 14 to 15, 2002, at 120 East Watkins contained 170 ppb benzene (approximately 547 $\mu g/m^3$). (Dondanville Test. Day 2 at 176; Pl. Ex. 321 at APEXDEPO_001312; Pl. Ex. 120 at APEXDEPO_001316-324). Samples collected at 116 East Watkins over the next two days, May 16-17 and May 17-18, first found benzene at 266 ppb (approximately 857 $\mu g/m^3$) and then at 135 ppb (approximately 435 $\mu g/m^3$). (Dondanville Test. Day 2 at 176-177; Pl. Ex. 321 at APEXDEPO_001312).

232. All of those benzene levels in homes on East Watkins Street – 330 ppb, 269 ppb, 266 ppb, 170 ppb, and 135 ppb – were more than 10 times higher than ATSDR's 9 ppb acute inhalation Minimal Risk Level for benzene. (Pl. Ex. 247 at ATSDR000932). For comparison, cigarette smoking can be a significant source of benzene in indoor air, and ATSDR's Toxicological Profile for Benzene reports that indoor air samples taken from smoke-filled bars contained 8.08-11.3 ppb benzene. (Pl. Ex. 247 at ATSDR000815). The highest benzene level found in basements at the Love Canal site in Niagara Falls, New York was 162.8 ppb. (Pl. Ex. 247 at

ATSDR000815).

233. Elevated hexane levels also were measured in the East Watkins Street homes during the week of May 13, 2002:

Residence	Sampling Date	Hexane Concentration
130 East Watkins	May 13-14, 2002	12,218 ppb (approx. 43,007 $\mu g/m^3$)
134 East Watkins	May 13-14, 2002	11,873 ppb (approx. 41,793 $\mu g/m^3$)
120 East Watkins	May 14-15, 2002	5,662 ppb (approx. 19,930 $\mu g/m^3$)
116 East Watkins	May 15-16, 2002	9,105 ppb (approx. 32,050 $\mu g/m^3$)
116 East Watkins	May 16-17, 2002	4,380 ppb (approx. 15,418 $\mu g/m^3$)

(Dondanville Test. Day 2 at 176, 178; Pl. Ex. 321 at APEXDEPO_001312; Pl. Ex. at 260 at ATSDR001155).

234. The family that lived at 134 East Watkins stayed out of their home, first at a relative's house and then at a hotel, from May 13 until the end of May when additional sampling indicated that the hydrocarbon levels in their house had diminished. (Dondanville Test. Day 2 at 185; Pl. Ex. 117 at APEXDEPO001288).

235. The May 2002 sampling data was analyzed by the Illinois EPA laboratory in Springfield, Illinois. Although the Illinois EPA lab is not independently certified, IDPH and the Illinois EPA Collinsville office considered the lab's results reliable because the lab followed a standard methodology, had significant experience

performing this type of analysis, owned the sampling and analytical equipment and had operated it for a long time, and quality-controlled their data. (Dondanville Test. Day 2 at 181; Pl. Ex. 117 at APEXDEPO001288). The information had been gathered for informational purposes to inform residents of potential exposures and the information that was provided directly to the residents included the laboratory's disclaimer that it was not independently certified. (Dondanville Test. Day 2 at 182).

236. Several weeks of heavy rain had preceded the May 2002 vapor intrusion events on East Watkins Street. (Dondanville Test. Day 2 at 167; Pl. Ex. 321 at APEXDEPO_001305). Flooding occurred in Hartford during this time, with some residents applying for flood relief. (Dondanville Test. Day 2 at 167).

237. The basements of the East Watkins Street homes lie in a silt layer and are only separated from the Main Sand by approximately five feet of silty-clay. (Pl. Ex. 199 at EPA_RPT026243). ROST sampling in the area identified a 15-foot thickness of residual-phase light-range hydrocarbons (gasoline) in the Main Sand at monitoring point HROST-50, located on Watkins Street in front of 116 East Watkins Street. (Pl. Ex. 199 at EPA_RPT026185, 243). ROST sampling at HROST-51, located in front of 134 East Watkins, shows both 15 feet of light-range residual hydrocarbon in the Main Sand and heavy-range residual hydrocarbons (such as Six Oil) in the silty-clay strata, less than 5 feet below nearby homes' basements. (Pl. Ex. 199 at EPA_RPT026185, 243). Additionally, a sewer line runs beneath East Watkins Street and lies in the silt and silty-clay layer. (Pl. Ex. 199 at EPA_RPT026243).

XXIII. ATSDR / IDPH Health Consultations and Health Assessment

238. A Health Consultation is an ATSDR document that addresses a specific health-related question about a site and a specific exposure pathway. (Watters Test. Day 4 at 32-33). A Public Health Assessment is an ATSDR document that includes a broader scope of review of potential community concerns and issues, reviewing multiple pathways and possibly multiple chemicals. (Watters Test. Day 4 at 33). Health Consultations and Public Health Assessments can be prepared by ATSDR or by certain states in conjunction with ATSDR pursuant to ATSDR's State Cooperative Agreement Program. (Watters Test. Day 4 at 33). State-prepared Health Consultations and Public Health Assessments are overseen by ATSDR technical project officers and circulated to additional ATSDR divisions for review and comment. (Watters Test. Day 4 at 34-36).

239. In their conclusions, Health Consultations and Public Health Assessments normally characterize potential public health hazards using established terms such as "no public health hazard," "no apparent public health hazard," "indeterminate," "public health hazard," or "urgent public health hazard." (Watters Test. Day 4 at 43-44). The term "public health hazard" is generally used by ATSDR to reflect chronic risks or risks which may occur after one year, whereas "urgent" public health hazards generally occur within one year. (Watters Test. Day 4 at 44).

240. IDPH forwarded ATSDR the results of the indoor air sampling at East Watkins Street homes in mid-May 2002. (Dondanville Test. Day 2 at 165). In light of the high concentrations of hydrocarbons found in the homes, ATSDR

recommended that IDPH draft a Health Consultation. (Dondanville Test. Day 2 at 165).

241. In July 2002, IDPH and ATSDR issued the Health Consultation, entitled "Vapors in Hartford Homes." (Pl. Ex. 321). The Health Consultation compared levels of benzene and other hydrocarbon constituents found in the East Watkins Street homes during the week of May 13, 2002 with health-based comparison values and concluded that residential vapor intrusion in Hartford constituted a public health hazard for persons in affected homes. (Dondanville Test. Day 2 at 173-174; Pl. Ex. 321 at APEXDEPO_001308). The Health Consultation also concluded that similar weather conditions could lead to additional vapor intrusion events which could present an urgent public health hazard. (Dondanville Test. Day 2 at 174; Pl. Ex. 321 at APEXDEPO_001308-309).

242. In June 2003, IDPH and ATSDR issued a Public Health Assessment that was entitled "Hartford Residential Vapor Exposures." (Pl. Ex. 326). This document incorporated the air sampling results detailed in the 2002 Health Consultation as well as some follow-up sampling. (Dondanville Test. Day 2 at 189). The Public Health Assessment also compiled information collected from residents through 112 completed questionnaires regarding past odor complaints and health concerns. (Dondanville Test. Day 2 at 190-191; Pl. Ex. 326 at APEXDEPO_001495-496, 511-516). The Public Health Assessment concluded that residential vapor intrusion in Hartford had constituted a public health hazard for persons in affected homes and could again pose a public health hazard in the future. (Dondanville Test. Day 2 at

193; Pl. Ex. 326 at APEXDEPO_001498).

243. In September 2005, IDPH and ATSDR issued a Health Consultation regarding certain quarterly indoor air sampling that IDPH had performed in Hartford. (Pl. Ex. 156). Development of that Health Consultation had been recommended by the 2004 Public Health Assessment, to attempt to capture seasonal variations in vapor intrusion. (Watters Test. Day 4 at 38). In the 2005 Health Consultation, IDPH concluded that long-term exposure to benzene and 1,3-butadiene in homes from vapor intrusion constituted a public health hazard to persons in affected homes. (Pl. Ex. 156 at APEXDEPO_000294).

244. IDPH also concluded that conditions still existed in Hartford that could cause high-level vapor intrusion to occur again, which could amount to an urgent public health hazard. (Pl. Ex. 156 at APEXDEPO_000294). That IDPH report focused on chronic risks and at least one ATSDR public health professional expressed concern that the Health Consultation did not adequately reflect the importance of potential acute risks posed by vapor intrusion in Hartford. (Watters Test. Day 4 at 40; Pl. Ex. 150).

XXIV. U.S. EPA Involvement at Site

245. On May 9, 2003, the Illinois EPA requested that the U.S. EPA "assign an On-Scene Coordinator [("OSC")] to conduct a time critical removal assessment, assess current site conditions, and determine if possible removal actions are warranted at the North Hartford Premcor Site located in Hartford, Madison County,

Illinois." (Uncontroverted Facts at Para. 28). U.S. EPA assigned two On-Scene Coordinators, Steve Faryan and Kevin Turner, to begin assessing the conditions at the Site and to develop short-term and long-term plans for addressing the problems at the Site. (Uncontroverted Facts at Para. 28; Turner Test. Day 9 at 167-68, 174-176).

246. U.S. EPA assumed primary responsibility for addressing the problems at the Hartford Site in the summer of 2003. (Turner Test. Day 9 at 168, 174-75; Def. Ex. 47). On August 14, 2003, Illinois EPA sent U.S. EPA a memorandum that recounted some of the history regarding the Hartford matter. (Uncontroverted Facts at Para. 29). The memorandum concluded: "The results appear to be an imminent threat to the residents and the Illinois EPA requests USEPA's assistance in moving quickly towards a resolution for the people of the Village of Hartford." (Uncontroverted Facts at Para. 29).

247. In August 2003, U.S. EPA held a meeting with five oil companies that U.S. EPA believed bore legal responsibility for the Site. That meeting was attended by representatives of Premcor Refining Group Inc. ("Premcor"), Equilon Enterprises LLC (doing business as Shell Oil Products US) ("Shell Oil"), Atlantic Richfield Company (an affiliate of BP Amoco) ("BP Amoco"), Sinclair Oil Corp. ("Sinclair"), and Apex Oil. At that meeting, U.S. EPA representatives told those companies that U.S. EPA wanted them to enter into an Administrative Order on Consent for performance of required cleanup work at the Site, and U.S. EPA threatened to take enforcement action if a near-term agreement could not be reached. (Turner Test. Day 9 at 175;

Def. Ex. 50; Def. Ex. 52).

248. Three of the oil companies – Premcor, Shell Oil, and BP Amoco – ultimately expressed a willingness to enter into an Administrative Order on Consent for performance of certain work at the Site. Throughout the fall of 2003 and the spring of 2004, U.S. EPA negotiated an Administrative Order on Consent with those three companies. (Turner Test. Day 9 at 176, 181-82; Pl. Ex. 145).

249. At the same time, U.S. EPA prepared a formal Determination of Threat Memorandum (the "Threat Memorandum") that documented the determination of an imminent and substantial endangerment to public health and the environment based on several known threats posed by the plume of hydrocarbons located beneath the Village of Hartford. (Faryan Test. Day 1 at 107; Pl. Ex. 146 at APEXDEPO_005322, 327-328). U.S. EPA finalized the Threat Memorandum on March 15, 2004. (Pl. Ex. 146).

250. U.S. EPA's Threat Memorandum found that there were risks at the Site due to "actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants," based on the ATSDR / IDPH finding of a public health hazard posed by vapor intrusion, as set forth in the Public Health Assessment (Pl. Ex. 210; Faryan Test. Day 1 at 122; Pl. Ex. 146 at APEXDEPO_005322, 327). U.S. EPA also determined that there were risks due to a "threat of fire and explosion," based on historical evidence of hydrocarbon-related fires. (Faryan Test. Day 1 at 123; Pl. Ex. 146 at APEXDEPO_005322, 327).

251. U.S. EPA's Threat Memorandum cited risks associated with "actual or

potential contamination of drinking water supplies or sensitive ecosystems," based on groundwater sampling showing benzene concentrations that were thousands of times higher than relevant drinking water standards at locations near the recharge zone for the Village of Hartford's drinking water supply well, and based on the existence of potential pathways for contamination to reach the Mississippi River. (Faryan Test. Day 1 at 123; Pl. Ex. 146 at APEXDEPO_005327). U.S. EPA determined that there were "weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released," because rising Mississippi River water levels or storm events may drive vapors into homes, directly or via sewers. (Faryan Test. Day 1 at 124; Pl. Ex. 146 at APEXDEPO_005328). Finally, the Threat Memorandum found an "unavailability of other appropriate federal or state response mechanisms to respond to the release," due to Illinois EPA's referral of the Hartford matter to U.S. EPA for assistance. (Faryan Test. Day 1 at 124; Pl. Ex. 146 at APEXDEPO_005328).

252. An Administrative Order on Consent was entered on March 17, 2004 between the U.S. EPA and Premcor, Shell Oil, and BP Amoco. (Pl. Ex. 145). Sinclair later joined in the efforts undertaken by that group of companies, which became known as the Hartford Working Group. (Faryan Test. Day 1 at 129; Turner Test. Day 9 at 176). To date, Apex Oil has refused to help finance or participate in any of the activities that have been undertaken by the Hartford Working Group. (Turner Test. Day 9 at 177, 182).

253. U.S. EPA's Administrative Order on Consent required the Hartford

Working Group to take a number of actions at the Site, including: (I) implementing several types of Interim Measures to try to address the most immediate vapor intrusion problems at the Site; (ii) conducting a series of studies to characterize the nature and extent of hydrocarbon contamination at the Site; and (iii) proposing and designing an Active Recovery System for hydrocarbon contamination beneath the Village. (Turner Test. Day 9 at 177-78; Pl. Ex. 145 at APEXDEPO_005319-21). The Administrative Order on Consent required all that work to be done under U.S. EPA's supervision and oversight. (Turner Test. Day 9 at 177; Pl. Ex. 145 at APEXDEPO_005297-300).

254. The specific work required under the Administrative Order of Consent is set forth in Appendix B to that document. (Faryan Test. Day 1 at 130; Pl. Ex. 145 at APEXDEPO_005319-321). The work identified in Appendix B has for the most part been completed, with the exception of some additional dissolved-phase groundwater investigation work. (Faryan Test. Day 1 at 130).

XXV. Interim Measures

A. Contingency Plan

255. One of the first steps taken under the Administrative Order on Consent was an effort to formalize a Contingency Plan to ensure a prompt response to any vapor complaint, fire, or explosion in Hartford. (Faryan Test. Day 1 at 136; Pl. Ex. 250 at EPA_RPT035225). Under the Contingency Plan, residents are advised to contact the Hartford Fire Department, which can respond quickly, screen the home

for explosive vapor concentrations, and ventilate the home as necessary. (Faryan Test. Day 1 at 137-38; Pl. Ex. 250 at EPA_RPT035225-26).

256. Decisions about recommending voluntary evacuations are made by the state and federal agencies and/or the Hartford Fire Department. (Faryan Test. Day 1 at 140-41; Pl. Ex. 250 at EPA_RPT035226-227). If a voluntary evacuation is recommended, the Hartford Working Group will provide alternative lodging arrangements for the affected residents. (Faryan Test. Day 1 at 140; Pl. Ex. 250 at EPA_RPT035227). There have been approximately 15 voluntary evacuations since U.S. EPA became involved at the Site, with the most recent occurring in 2007. (Faryan Test. Day 1 at 140).

257. In addition to the Contingency Plan, the Administrative Order on Consent required the Hartford Working Group to institute two other main types of Interim Measures: In-Home Interim Measures and an enhanced and expanded area-wide Vapor Control System. (Turner Test. Day 9 at 177, 182-83).

B. The In-Home Interim Measures Program

258. The In-Home Interim Measures program involves a series of efforts to assess and mitigate the potential for vapor intrusion on a home-by-home basis in North Hartford. All homeowners in North Hartford were invited to participate in the program and U.S. EPA and the Hartford Working Group both conducted extensive outreach activities to encourage participation. (Faryan Test. Day 2 at 6; Turner Test. Day 9 at 183; Def. Ex. 663; Def. Ex. 667).

259. Once a homeowner agrees to participate in the In-Home Interim

Measures program, a contractor for the Hartford Working Group visits the home for an initial "needs assessment." During the needs assessment, the contractor completes a standard written survey based on an interview with the resident, conducts preliminary air monitoring, and inspects the home for potential vapor intrusion pathways (such as dirt-floored areas in crawl spaces and basements, cracked basement walls and floors, and unsealed basement floor drains). (Faryan Test. Day 2 at 6-10; Turner Test. Day 9 at 183; Def. Ex. 1042).

260. To date, the Hartford Working Group has completed needs assessments in more than 160 homes in North Hartford. (Turner Test. Day 9 at 184).

261. After the needs assessment, the Hartford Working Group's contractor normally sends the homeowner a letter that includes a copy of the completed survey, the results of the preliminary air sampling, and an offer to install a proposed "mitigation package" for the particular home. The proposed mitigation package is customized based on the results of the needs assessment in that home, and it may include steps such as pouring new concrete flooring in dirt-floored crawl space or basement areas, sealing existing cracks in basement walls or floors with caulks and paints, installing one-way valves on floor drains to limit vapor intrusion, and installing vent fans and explosive gas detectors. (Faryan Test. Day 2 at 13-16; Turner Test. Day 9 at 184; Def. Ex. 1042).

262. In some cases, the mitigation package has included installation of an entire sub-slab depressurization system that is designed to collect hydrocarbon vapors beneath the foundation of the home and vent them to the air above the home's

roof-line. (Faryan Test. Day 2 at 13-14; Cahnovsky Test. Day 3 at 128-133; Turner Test. Day 9 at 184).

263. Once a homeowner accepts a mitigation package offered by the Hartford Working Group, a contractor also begins performing regular air monitoring at the home. Indoor air samples normally are collected inside the home on a quarterly basis. In some cases, gases beneath the home also are sampled on a quarterly basis using specially-installed sub-slab monitoring ports. (Faryan Test. Day 2 at 15-17; Turner Test. Day 9 at 184).

264. During the quarterly air monitoring visits, the Hartford Working Group's contractor also inspects the measures that are in place at the home to determine whether additional steps need to be taken (such as re-sealing cracks in basement walls and floors). (Faryan Test. Day 2 at 16-17; Turner Test. Day 9 at 184).

265. There are approximately 230 homes in North Hartford. (Pl. Ex. 178 at EPA_RPT001033). The owners of about one-half of those homes in North Hartford have accepted a mitigation package and are participating in the quarterly monitoring and follow-up inspections under the In-Home Interim Measures program. (Faryan Test. Day 2 at 16; Turner Test. Day 9 at 184; Pl. Ex. 178 at EPA_RPT001033). As required by the Administrative Order on Consent, the Hartford Working Group has borne the cost of the In-Home Interim Measures, including the cost of all mitigation measures installed in individual homes and the cost of all ongoing monitoring and follow-up work. (Pl. Ex. 145; Turner Test. Day 11 at 197).

C. The Area-Wide Vapor Control System

266. When U.S. EPA assumed a lead role for the Site in 2003, there was a pre-existing Vapor Control System that the oil companies had installed in the Village in the early 1990s. (Faryan Test. Day 1 at 146-47; Turner Test. Day 9 at 168-69, 172-73; Pl. Ex. 203 at EPA_0038412; Pl. Ex. 358). The pre-existing Vapor Control System included a set of twelve soil vapor extraction wells beneath a few streets in the northernmost portion of North Hartford. (Faryan Test. Day 1 at 146-47; Turner Test. Day 9 at 172-73; Pl. Ex. 358 at EPA_RPT035917). That system was originally installed after a spate of hydrocarbon odor complaints and several fires in 1990. (Pl. Ex. 191 at EPA_RPT022288-289, 291; Def. Ex. 586 at 47-48 (Table 2 at 6-7)).

267. The original Vapor Control System was designed to mitigate vapor intrusion problems in certain areas by drawing sub-surface hydrocarbon vapors into the twelve soil vapor extraction wells. Those wells were connected by buried piping that ran to a thermal treatment unit, which burned the vapors to destroy them on part of the Hartford Refinery property located just east of the Village. (Faryan Test. Day 1 at 146-48; Turner Test. Day 9 at 172-73; Pl. Ex. 358 at EPA_RPT035917).

268. In 2003, U.S. EPA quickly determined that the existing Vapor Control System had two major problems. First, the existing twelve well System had very limited coverage. Second, the wells themselves were poorly-designed and poorly-maintained, so their potential effectiveness was greatly diminished by algae-like biological fouling that had accumulated in the wells by 2003. (Faryan Test. Day 1 at 148-151; Turner Test. Day 9 at 186-87; Pl. Ex. 358 at EPA_RPT0035900-05).

269. The Hartford Working Group began making a series of improvements

and enhancements to the Vapor Control System under the Administrative Order on Consent. (Turner Test. Day 9 at 188; Def. Ex. 660; Def. Ex. 661; Def. Ex. 662).

270. The Hartford Working Group first replaced the twelve original soil vapor extraction wells with new, better-designed wells, and those replacement wells were connected to the existing piping. (Faryan Test. Day 1 at 151; Turner Test. Day 9 at 188).

271. In the summer and fall of 2004, the Hartford Working Group made an initial expansion to the Vapor Control System, called the "Phase 1" expansion. Among other things, the Phase 1 expansion added new wells along Watkins Street, where there had been recent vapor intrusion problems. (Pl. Demo. Ex. 507; Turner Test. Day 9 at 188-91; Def. Ex. 662).

272. In early 2005, the Hartford Working Group added a "Phase 2" expansion to the Vapor Control System, largely in response to severe vapor intrusion problems near the Hartford Community Center. That expansion added new soil vapor extraction wells and piping in the northernmost portion of North Hartford near the Hartford Community Center, including along West Arbor Street and West Birch Street. (Turner Test. Day 9 at 191; Pl. Demo. Ex. 507; Pl. Ex. 175 at EPA_RPT000722-24; Pl. Ex. 187).

273. The Hartford Working Group completed a "Phase 3" expansion of the Vapor Control System in 2007. That expansion improved the System's overall coverage by adding dozens of new soil vapor extraction wells and associated piping along West Date Street, Elm Street, West Forest Street, East Cherry Street, North

Delmar Avenue, North Market Street, and North Olive Street. (Turner Test. Day 9 at 192-193; Pl. Demo. Ex. 507).

D. Limitations of the Interim Measures

274. Although the In-Home Interim Measures program and the expanded Vapor Control System have helped to limit vapor intrusion problems in North Hartford, those Interim Measures have not eliminated those problems entirely, and they do not target the subsurface hydrocarbon contamination that is the source of the problems. (Turner Test. Day 9 at 194).

275. Many of the soil vapor extraction wells in the existing Vapor Control System are screened at relatively shallow depths for vapor intrusion mitigation (such as in the A Clay, North Olive and Rand stratigraphic units), so they are not efficient in accomplishing mass removal of free-phase and residual-phase hydrocarbon contamination in deeper soil layers (such as in the Main Sand and Main Silt strata). (Turner Test. Day 9 at 194; Pl. Ex. 203 at EPA_RPT038469; Pl. Ex. 206 at EPA_RPT0039917-18).

276. The In-Home Interim Measures program does not encompass all potentially-affected homes in North Hartford because some homeowners have declined to participate in that voluntary program. As a result, the program only encompasses about one-half of the homes in North Hartford. (Faryan Test. Day 2 at 14-16; Pl. Ex. 178 at EPA_RPT001033). That program also is intrusive for homeowners, labor-intensive, and costly. (Turner Test. Day 9 at 194-95).

277. At best, the Interim Measures represent a partial and temporary

mitigation measure for the problems associated with the hydrocarbon contamination beneath the Village. (Turner Test. Day 9 at 194-95).

XXVI. Evaluation of Indoor Air and Sub-Slab Sampling Data

278. A contractor for the Hartford Working Group regularly collects air samples at various indoor locations and at sub-slab monitoring points pursuant to an Effectiveness Monitoring Plan under the In-Home Interim Measures program. (Watters Test. Day 4 at 56-57). To judge that data, the government agencies also have established health-based "Comparison Values" for particular hydrocarbon compounds. (Watters Test. Day 4 at 22, 52-53). When there are exceedences of Comparison Values for chemicals in sub-slab samples, but not in the indoor air, the potential for vapor intrusion into the residence still exists due to the proximity of the vapors to the interior of the home. (Watters Test. Day 4 at 58). Where there are exceedences in both the indoor air and the sub-slab samples, vapor intrusion is likely occurring with the sub-slab vapors at least contributing to indoor air levels. (Watters Test. Day 4 at 58). Where there are exceedences in indoor air, but not in the sub-slab samples, indoor air concentrations may be due to an interior source rather than vapor intrusion. (Watters Test. Day 4 at 58-59).

XXVII. Hydrocarbon Vapors at the Hartford Community Center

A. Complaints and Vapor Intrusion Events

279. There is a long and well-documented history of vapor intrusion

problems at the property on North Delmar Avenue and Arbor Street that is now occupied by the Hartford Community Center (which was the former site of the Woodrow Wilson School). There were odor complaints at the location in 1966, 1968, 1978, 1981, 1995, and 2004. (Pl. Ex. 176 at EPA_RPT001918-19).

280. The Hartford Community Center has been used for a meals program for senior citizens and for holding public meetings. (Faryan Test. Day 1 at 215). On March 8, 2004, a vapor complaint was reported at the Community Center and elevated explosivity readings (5% LEL) were measured by the Hartford Fire Department. (Pl. Ex. 154; Pl. Ex. 176 at EPA_RPT001846; Faryan Test. Day 1 at 216).

281. A U.S. EPA On-Scene Coordinator, Steve Faryan, was among the responders and smelled a diesel-like odor in the Community Center, especially in the basement near the boiler room and evidence room (which is also called the police storage room). (Faryan Test. Day 1 at 215). Readings that were taken with handheld instruments that used a photo ionization detector ("PID") and flame ionization detector ("FID") indicated that the source of the vapors appeared to be an abandoned 2-inch pipe discovered beneath broken concrete in the police storage room. (Pl. Ex. 176 at EPA_RPT001846; Faryan Test. Day 2 at 131). Mr. Faryan could hear the vapors hissing as they came into the building through cracks around the pipe. (Faryan Test. Day 1 at 216: Faryan Test. Day 2 at 116-117, 131). The pipe formerly connected the Community Center building to a school building that had been demolished years before. (Faryan Test. Day 2 at 131). The pipe was not found in a

test pit dug outside the Community Center for the purpose of determining the extent of the pipe and it was determined that the pipe was simply cut off at the Community Center building's foundation wall when the former school building was demolished in the early 1970s. (Pl. Ex. 176 at EPA_RPT001846-847, 857).

282. In light of explosivity measurements taken by the Fire Department, the Community Center was evacuated and vented on March 8, 2004. (Pl. Ex. 176 at EPA_RPT001846; Faryan Test. Day 1 at 216). On March 9, 2004, the pipe in the police storage room was sealed and the overlying concrete was repaired and sealed. (Pl. Ex. 176 at EPA_RPT001846; Faryan Test. Day 1 at 216).

283. Residents of at least seven homes in North Hartford also complained of hydrocarbon odors between March 4 and March 22, 2004. (Pl. Ex. 234). A number of the homes were quite close to the Community Center (at 707 North Delmar Avenue, 121 and 123 West Arbor Street, and 129 West Birch Street), but others were several blocks away, to the south and east (at 122 East Date Street, 118 East Date Street, 111 West Date Street, and 310 North Delmar Avenue). (Pl. Ex. 234; Pl. Ex. 366 at IEPA001099, 1103; Pl. Ex. 367 at IEPA001111-12; Pl. Demo Ex. 621). Field instruments measured hydrocarbon gases at 18% of the lower explosive limit inside the home at 707 North Delmar Avenue on March 11, 2004. (Pl. Ex. 234 at APEX001126).

284. A contractor for the Hartford Working Group collected indoor air samples from several of those homes. (Pl. Ex. 234). At least one of the homes was not sampled because the residents did not want to allow strangers into their house.

(Pl. Ex. 234 at APEX001126). The laboratory analyses of the samples that were taken showed highly-elevated levels of individual hydrocarbons in several of the homes, including indoor air isopentane levels that were as high as 50,000 $\mu g/m^3$ and hexane levels at up to 5,700 $\mu g/m^3$. (Def. Ex. 1115 at 41-42, 66). An elderly resident of one of the homes with the highest hydrocarbon concentrations was offered alternative lodging, but he declined. (Pl. Ex. 234 at APEX001125; Def. Ex. 1115 at 42-43). The residents of another home accepted a similar offer to stay in a hotel until the vapors in their house subsided. (Pl. Ex. 367 at IEPA001111-12).

285. Further work was done at the Community Center in the months after the March 2004 incidents. In July 2004, sub-slab monitoring ports were installed beneath the Community Center boiler room (designated monitoring point CC1), the hallway outside of the locker rooms (CC2), the men's locker room (CC3), the hallway outside the police storage room (CC4), and the cafeteria storage room (CC5). (Pl. Ex. 187 at EPA_RPT031027, 029). In August 2004, a contractor for the Hartford Working Group conducted sealing work in the basement and reversed the flow of a vent fan that had been installed in the police storage room in March. (Pl. Ex. 187 at EPA_RPT031027). In December 2004, additional sub-slab monitoring points were installed beneath the Community Center hallway (CC6), cafeteria (CC7 - southwest, CC8 - southeast, CC9 - northeast), police storage room (CC10), boiler room (CC11), and women's locker room (CC12). (Pl. Ex. 187 at EPA_RPT031028-29).

286. Indoor air and sub-slab sampling was conducted to assess potential threats to Community Center users and to determine when the building could be re-

opened to the public. (Faryan Test. Day 1 at 217-218). Indoor air samples reflect actual concentrations of vapors to which individuals would have been exposed at the sampling location. (Faryan Test. Day 1 at 219-220). Indoor air sampling was conducted beginning in April 2004 and from August 2004 to June 2005. That indoor sampling was generally conducted on a weekly basis at eight basement locations. (Pl. Ex. 187 at EPA_RPT031028). Indoor air sample concentrations for benzene included:

Benzene ($\mu g/m^3$)	Location	Date	Page Citations in Pl. Ex. 187
980	cafeteria storage room	1/6/05	EPA_RPT031037; EPA_RPT031109
570	under west stairs	1/6/05	EPA_RPT031039; EPA_RPT031173
240	cafeteria	1/6/05	EPA_RPT031036; EPA_RPT031093
220	cafeteria storage room	7/30/04	EPA_RPT031105
210	kitchen	1/6/05	EPA_RPT031037; EPA_RPT031135
200	cafeteria storage room	11/23/04	EPA_RPT031037; EPA_RPT031107
190	cafeteria storage room	11/10/04	EPA_RPT031037; EPA_RPT031107
180	cafeteria storage room	9/8/04	EPA_RPT031037; EPA_RPT031105
170	cafeteria storage room	9/22/04	EPA_RPT031037; EPA_RPT031105
170	cafeteria storage room	11/3/04	EPA_RPT031037; EPA_RPT031107

Benzene ($\mu g/m^3$)	Location	Date	Page Citations in Pl. Ex. 187
160	evidence hallway	4/6/04	EPA_RPT031115
150	men's bathroom	4/11/05	EPA_RPT031039; EPA_RPT031150
140	cafeteria storage room	1/12/05	EPA_RPT031037; EPA_RPT031109
130	cafeteria storage room	9/15/04	EPA_RPT031105
130	kitchen closet	8/25/04	EPA_RPT031038; EPA_RPT031125
120	cafeteria storage room	9/15/04	EPA_RPT031037; EPA_RPT031105
110	men's bathroom	6/17/04	EPA_RPT031141
98	cafeteria	4/6/04	EPA_RPT031090
74	cafeteria	11/3/04	EPA_RPT031036; EPA_RPT031093
72	men's bathroom	11/3/04	EPA_RPT031039; EPA_RPT031141
71	cafeteria storage room	9/2/04	EPA_RPT031037; EPA_RPT031105
69	kitchen	11/3/04	EPA_RPT031037; EPA_RPT031135
66	men's bathroom	1/6/05	EPA_RPT031039; EPA_RPT031144
65	kitchen	8/18/04	EPA_RPT031037; EPA_RPT031133
61	kitchen closet	11/23/04	EPA_RPT031038; EPA_RPT031127
54	cafeteria storage room	8/27/04	EPA_RPT031037; EPA_RPT031105
56	cafeteria storage room	11/18/04	EPA_RPT031037; EPA_RPT031107

Benzene ($\mu g/m^3$)	Location	Date	Page Citations in Pl. Ex. 187
55	men's bathroom	6/16/04	EPA_RPT031039; EPA_RPT031141
49	evidence hallway	8/18/04	EPA_RPT031038; EPA_RPT031115
48	cafeteria storage room	4/20/05	EPA_RPT031037; EPA_RPT031111
48	men's bathroom	4/6/05	EPA_RPT031039; EPA_RPT031150
47	women's locker room	6/17/04	EPA_RPT031179
47	men's bathroom	4/6/05	EPA_RPT031039; EPA_RPT031150
46	cafeteria storage room	10/13/04	EPA_RPT031037; EPA_RPT031105
44	cafeteria	9/2/04	EPA_RPT031036; EPA_RPT031090
44	cafeteria	9/8/04	EPA_RPT031036; EPA_RPT031090
43	cafeteria	1/12/05	EPA_RPT031036; EPA_RPT031093
41	men's bathroom	1/12/05	EPA_RPT031039; EPA_RPT031144

287. Some of those indoor air values are about 30 times higher than the acute MRL for benzene. (Weis Test. Day 4 at 213-14).

288. Sub-slab concentrations reflect the potential range of exposure to persons inside the building, if the vapors infiltrated the structure. (Faryan Test. Day 1 at 222-223). Sub-slab concentrations were collected at monitoring points CC1

through CC5 once in July 2004 and then generally on a weekly basis from November 2004 through May 2005. (Pl. Ex. 187 at EPA_RPT031029). Sub-slab concentrations were collected at monitoring points CC6 through CC12 generally on a weekly basis from December 2004 through May 2005. The sub-slab concentrations for benzene included:

Benzene ($\mu g/m^3$)	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
850,000	CC5 (cafeteria closet)	7/30/04	EPA_RPT031206
750,000	CC3 (men's locker room)	7/30/04	EPA_RPT031194
620,000	CC3 (men's locker room)	11/30/04	EPA_RPT031194
620,000	CC2 (hallway closet)	1/12/05	EPA_RPT031188
620,000	CC3 (men's locker room)	1/12/05	EPA_RPT031194
600,000	CC3 (men's locker room)	1/31/05	EPA_RPT031196
570,000	CC5 (cafeteria closet)	11/12/04	EPA_RPT031206
570,000	CC5 (cafeteria closet)	11/18/04	EPA_RPT031206
550,000	CC3 (men's locker room)	1/7/05	EPA_RPT031194
540,000	CC2 (hallway closet)	7/30/04	EPA_RPT031188
530,000	CC2 (hallway closet)	1/7/05	EPA_RPT031188
510,000	CC2 (hallway closet)	11/30/04	EPA_RPT031188
500,000	CC9 (NE cafeteria)	12/13/04	EPA_RPT031226
500,000	CC3 (men's locker room)	12/28/04	EPA_RPT031194
470,000	CC2 (hallway closet)	12/15/04	EPA_RPT031188
450,000	CC2 (hallway closet)	1/25/05	EPA_RPT031190
440,000	CC2 (hallway closet)	1/31/05	EPA_RPT031190
430,000	CC5 (cafeteria closet)	1/12/05	EPA_RPT031206
430,000	CC2 (hallway closet)	1/18/05	EPA_RPT031190

Benzene ($\mu g/m^3$)	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
410,000	CC5 (cafeteria closet)	11/30/04	EPA_RPT031206
380,000	CC3 (men's locker room)	1/25/05	EPA_RPT031196
350,000	CC9 (NE cafeteria)	12/21/04	EPA_RPT031226
340,000	CC2 (hallway closet)	11/12/04	EPA_RPT031188
340,000	CC3 (men's locker room)	12/15/04	EPA_RPT031194
340,000	CC8 (SE cafeteria)	1/31/05	EPA_RPT031222
320,000	CC7 (SW cafeteria)	1/31/05	EPA_RPT031214
310,000	CC7 (SW cafeteria)	1/18/05	EPA_RPT031214
300,000	CC12 (women's locker room)	12/21/04	EPA_RPT031238
300,000	CC8 (SE cafeteria)	1/12/05	EPA_RPT031222
300,000	CC8 (SE cafeteria)	1/25/05	EPA_RPT031222
300,000	CC12 (women's locker room)	12/21/04	EPA_RPT031238
290,000	CC6 (hallway)	1/25/05	EPA_RPT031210
280,000	CC7 (SW cafeteria)	12/21/04	EPA_RPT031214
280,000	CC12 (women's locker room)	1/18/05	EPA_RPT031238
280,000	CC8 (SE cafeteria)	2/5/05	EPA_RPT031222
280,000	CC2 (hallway closet)	3/31/05	EPA_RPT031190
280,000	CC2 (hallway closet)	4/11/05	EPA_RPT031192
270,000	CC3 (men's locker room)	12/21/04	EPA_RPT031194
270,000	CC8 (SE cafeteria)	12/21/04	EPA_RPT031222
260,000	CC12 (women's locker room)	2/7/05	EPA_RPT031238
250,000	CC7 (SW cafeteria)	1/12/05	EPA_RPT031214
250,000	CC2 (hallway closet)	4/20/05	EPA_RPT031192
250,000	CC3 (men's locker room)	4/20/05	EPA_RPT031198

Benzene ($\mu g/m^3$)	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
240,000	CC2 (hallway closet)	12/21/04	EPA_RPT031188
240,000	CC7 (SW cafeteria)	1/25/05	EPA_RPT031214
230,000	CC8 (SE cafeteria)	1/18/05	EPA_RPT031222
230,000	CC12 (women's locker room)	1/31/05	EPA_RPT031238
210,000	CC3 (men's locker room)	2/5/05	EPA_RPT031196
200,000	CC3 (men's locker room)	2/7/05	EPA_RPT031196
180,000	CC8 (SE cafeteria)	4/20/05	EPA_RPT031224
180,000	CC12 (women's locker room)	2/18/05	EPA_RPT031238
170,000	CC9 (NE cafeteria)	1/12/05	EPA_RPT031226
170,000	CC3 (men's locker room)	3/18/05	EPA_RPT031198
170,000	CC7 (SW cafeteria)	4/20/05	EPA_RPT031216
160,000	CC6 (hallway)	1/31/05	EPA_RPT031210
160,000	CC8 (SE cafeteria)	2/7/05	EPA_RPT031222
160,000	CC12 (women's locker room)	2/25/05	EPA_RPT031238
150,000	CC2 (hallway closet)	3/18/05	EPA_RPT031190
140,000	CC8 (SE cafeteria)	2/8/05	EPA_RPT031222
140,000	CC7 (SW cafeteria)	3/31/05	EPA_RPT031214
130,000	CC8 (SE cafeteria)	3/31/05	EPA_RPT031224
110,000	CC12 (women's locker room)	4/20/05	EPA_RPT031240
97,000	CC7 (SW cafeteria)	3/18/05	EPA_RPT031214
94,000	CC5 (cafeteria closet)	4/20/05	EPA_RPT031208
91,000	CC6 (hallway)	3/18/05	EPA_RPT031212
85,000	CC3 (men's locker room)	1/18/05	EPA_RPT031196
84,000	CC7 (SW cafeteria)	2/7/05	EPA_RPT031214

Benzene ($\mu g/m^3$)	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
84,000	CC12 (women's locker room)	3/18/05	EPA_RPT031238
82,000	CC9 (NE cafeteria)	1/18/05	EPA_RPT031226
77,000	CC6 (hallway)	3/31/05	EPA_RPT031212
74,000	CC9 (NE cafeteria)	2/1/05	EPA_RPT031226
70,000	CC6 (hallway)	2/7/05	EPA_RPT031210
65,000	CC8 (SE cafeteria)	2/9/05	EPA_RPT031222
64,000	CC6 (hallway)	2/8/05	EPA_RPT031210
63,000	CC8 (SE cafeteria)	2/25/05	EPA_RPT031222
58,000	CC2 (hallway closet)	2/7/05	EPA_RPT031190
53,000	CC6 (hallway)	4/20/05	EPA_RPT031212
50,000	CC6 (hallway)	2/9/05	EPA_RPT031210
46,000	CC8 (SE cafeteria)	2/18/05	EPA_RPT031222
32,000	CC9 (NE cafeteria)	2/3/05	EPA_RPT031226
30,000	CC9 (NE cafeteria)	2/5/05	EPA_RPT031226
29,000	CC9 (NE cafeteria)	4/20/05	EPA_RPT031228
27,000	CC7 (SW cafeteria)	2/25/05	EPA_RPT031214
26,000	CC6 (hallway)	2/10/05	EPA_RPT031210
26,000	CC5 (cafeteria closet)	3/31/05	EPA_RPT031208
24,000	CC9 (NE cafeteria)	2/7/05	EPA_RPT031226
24,000	CC12 (women's locker room)	4/28/05	EPA_RPT031240
19,000	CC6 (hallway)	2/18/05	EPA_RPT031210
17,000	CC9 (NE cafeteria)	1/31/05	EPA_RPT031226
16,000	CC12 (women's locker room)	5/4/05	EPA_RPT031240
14,000	CC8 (SE cafeteria)	2/10/05	EPA_RPT031222

Benzene ($\mu g/m^3$)	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
13,000	CC7 (SW cafeteria)	2/18/05	EPA_RPT031214
11,000	CC12 (women's locker room)	3/31/05	EPA_RPT031238
11,000	CC6 (hallway)	4/28/05	EPA_RPT031212
8,800	CC3 (men's locker room)	3/31/05	EPA_RPT031198
8,500	CC9 (NE cafeteria)	2/8/05	EPA_RPT031226
8,200	CC9 (NE cafeteria)	2/9/05	EPA_RPT031226
8,100	CC5 (cafeteria closet)	3/18/05	EPA_RPT031208
7,500	CC3 (men's locker room)	2/8/05	EPA_RPT031196
6,600	CC8 (SE cafeteria)	4/28/05	EPA_RPT031224
6,200	CC1 (boiler room)	2/9/05	EPA_RPT031184

289. Some of those sub-slab readings are tens of thousands of times higher than the acute MRL for benzene. (Weis Test. Day 4 at 216).

290. Field instruments were used to take lower explosive limit (LEL) readings from the sub-slab monitoring points, generally on a weekly basis, from January 2005 through September 2005. (Pl. Ex. 187 at EPA_RPT031029, 242-254). LEL readings of 100% represent an explosive environment that only lacks an ignition source. (Faryan Test. Day 1 at 225). Elevated LEL readings beneath the boiler room are of especial concern as the boiler is a known potential ignition point. (Faryan Test. Day 1 at 225). LEL readings collected at the Community Center included:

% LEL	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
100%	CC1 (boiler room)	2/18/05	EPA_RPT031242

% LEL	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
100%	CC2 (hallway closet)	2/18/05	EPA_RPT031243
100%	CC3 (men's locker room)	2/18/05	EPA_RPT031244
100%	CC4 (evidence hallway)	2/18/05	EPA_RPT031245
100%	CC6 (hallway)	2/18/05	EPA_RPT031247
100%	CC7 (SW cafeteria)	2/18/05	EPA_RPT031248
100%	CC8 (SE cafeteria)	2/18/05	EPA_RPT031250
100%	CC10 (police storage room)	2/18/05	EPA_RPT031252
100%	CC11 (boiler room - west)	2/18/05	EPA_RPT031253
100%	CC12 (women's locker room)	2/18/05	EPA_RPT031254
21%	CC2 (hallway closet)	2/25/05	EPA_RPT031243
100%	CC4 (evidence hallway)	2/25/05	EPA_RPT031245
57%	CC6 (hallway)	2/25/05	EPA_RPT031247
100%	CC10 (police storage room)	2/25/05	EPA_RPT031252
11%	CC11 (boiler room - west)	2/25/05	EPA_RPT031253
69%	CC2 (hallway closet)	3/18/05	EPA_RPT031243
17%	CC4 (evidence hallway)	3/18/05	EPA_RPT031245
100%	CC5 (cafeteria closet)	3/18/05	EPA_RPT031246
100%	CC6 (hallway)	3/18/05	EPA_RPT031247
24%	CC7 (SW cafeteria)	3/18/05	EPA_RPT031248
68%	CC8 (SE cafeteria)	3/18/05	EPA_RPT031250
16%	CC2 (hallway closet)	4/6/05	EPA_RPT031243
100%	CC5 (cafeteria closet)	4/6/05	EPA_RPT031246
100%	CC6 (hallway)	4/6/05	EPA_RPT031247
30%	CC7 (SW cafeteria)	4/6/05	EPA_RPT031248

% LEL	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
69%	CC8 (SE cafeteria)	4/6/05	EPA_RPT031250
26%	CC10 (police storage room)	4/6/05	EPA_RPT031252
100%	CC2 (hallway closet)	4/11/05	EPA_RPT031243
99%	CC3 (men's locker room)	4/11/05	EPA_RPT031244
16%	CC4 (evidence hallway)	4/11/05	EPA_RPT031245
100%	CC5 (cafeteria closet)	4/11/05	EPA_RPT031246
100%	CC6 (hallway)	4/11/05	EPA_RPT031247
100%	CC7 (SW cafeteria)	4/11/05	EPA_RPT031248
100%	CC9 (NE cafeteria)	4/11/05	EPA_RPT031251
83%	CC10 (police storage room)	4/11/05	EPA_RPT031252
100%	CC11 (boiler room - west)	4/11/05	EPA_RPT031253
12%	CC12 (women's locker room)	4/11/05	EPA_RPT031254
100%	CC8 (SE cafeteria)	4/11/05	EPA_RPT031250
100%	CC1 (boiler room)	4/20/05	EPA_RPT031242
100%	CC2 (hallway closet)	4/20/05	EPA_RPT031243
100%	CC3 (men's locker room)	4/20/05	EPA_RPT031244
100%	CC4 (evidence hallway)	4/20/05	EPA_RPT031245
100%	CC5 (cafeteria closet)	4/20/05	EPA_RPT031246
100%	CC6 (hallway)	4/20/05	EPA_RPT031247
100%	CC7 (SW cafeteria)	4/20/05	EPA_RPT031248
100%	CC8 (SE cafeteria)	4/20/05	EPA_RPT031250
100%	CC9 (NE cafeteria)	4/20/05	EPA_RPT031251
100%	CC10 (police storage room)	4/20/05	EPA_RPT031252
100%	CC11 (boiler room - west)	4/20/05	EPA_RPT031253

% LEL	Sub-Slab Sampling Location	Date	Page Citations in Pl. Ex. 187
100%	CC12 (women's locker room)	4/20/05	EPA_RPT031254
13%	CC12 (women's locker room)	4/28/05	EPA_RPT031254

291. High sub-slab concentrations of explosive gases create a potential risk of fire or explosion inside the building because the vapors can enter the building and ignite or explode. (Pl. Ex. 165 at EXPRT000147-149, 153; Weis Test. Day 4 at 192, 208).

292. A general comparison of the indoor and sub-slab data showed that benzene and other hydrocarbon vapors were entering the Community Center building from the sub-slab soils, because some of the highest indoor levels were found on the same days as the highest sub-slab readings. (Faryan Test. Day 1 at 221).

293. A more detailed analysis of the Community Center data demonstrates a correlation between the indoor and sub-slab data that constitutes very strong evidence of vapor intrusion. (Weis Test. Day 3 at 212-18; Pl. Ex. 165 at EXRPT000162-63; Pl. Ex. 187 at EPA_RPT031042, 52). For example, levels of benzene (and other gasoline constituents like isopentane) in indoor air peaked in January 2005 and April 2005, just as the sub-slab levels were peaking. (Weis Test. Day 3 at 212-18; Pl. Ex. 165 at EXRPT00162-63; Pl. Ex. 187 at EPA_PRT31042, 44, 52, 54).

294. The January 2005 spike in indoor and sub-slab hydrocarbons gas

concentrations at the Community Center coincided with a 15 foot increase in Mississippi River levels and a corresponding five foot rise in groundwater levels during the first two weeks of that month. (Pl. Ex. 187 at EPA_RPT031052, 54; Pl. Ex. 200 at EPA_RPT041435-36). The indoor and sub-slab gas concentrations diminished in February during performance of a soil vapor extraction pilot test at three wells that were placed at shallow depths on the Community Center property (10-17 feet below ground surface). (Pl. Ex. 187 at EPA_RPT031052, 54; Def. Ex. 996 at 4, 6). The indoor and sub-slab hydrocarbon levels spiked again in mid-April 2005, as River levels and groundwater levels in the area rose again. (Pl. Ex. 187 at EPA_RPT031052, 54; Pl. Ex. 200 at EPA_RPT041436).

295. In April 2005, several new oil vapor extraction wells were installed and began operating as a temporary vapor control system on the Community Center property. Two of the wells collected vapors in the deeper soils and two operated at shallow depths. (Pl. Ex. 187 at EPA_RPT031028, 29, 32). By June 2005, substantial decreases in sub-slab vapor concentrations were noted at the Community Center. (Pl. Ex. 187 at EPA_RPT031028). The temporary soil vapor extraction system was designed to direct vapors to a portable blower unit and a portable thermal oxidizer unit that were located in the Community Center parking lot until the wells could be connected to the expanded area-wide Vapor Control System. (Faryan Test. Day 1 at 224; Pl. Ex. 187 at EPA_RPT031029-30).

B. Geology and Subsurface Contamination Near the Community Center

296. The geology and pattern of subsurface contamination near the Hartford

Community Center are especially complex.

297. The northernmost part of North Hartford near the Community Center contains significant deposits of several intermediate silt, silty-clay, and sand layers that thin substantially or disappear entirely just a few blocks to the south (i.e., the North Olive silt stratum, the B Clay, the Rand silt stratum, the C Clay, the EPA sand stratum, and the D Clay). (Pl. Ex. 199 at EPA_RPT026264-76). Geologic cross sections of the area also depict a pronounced mound in the Main Sand (a localized "structural high") immediately beneath the Community Center, between Rand Avenue and West Arbor Street. (Pl. Ex. 199 at EPA_RPT026241 (depicting a geologic cross section from B to B´, which passed through the Community Center property from north to south)).

298. Even in less permeable clay layers, the clay can have fractures (cracks) and there may be sandy seams within the clay that create preferential pathways for the movement of free-phase hydrocarbons and vapor-phase hydrocarbons. (Pl. Ex. 176 at EPA_RPT001874; Faryan Test. Day 1 at 209-210). A permeable lens in the B Clay was identified in a soil boring at monitoring well location HMW-46B, on the Hartford Community Center property. (Pl. Ex. 194 at EPA_RPT042939-40; Pl. Ex. 200 at EPA_RPT041421.) Fractures were observed in the A Clay in the test pits excavated at the Hartford Community Center in 2004. (Pl. Ex. 176 at EPA_RPT001873).

299. In the area near the Community Center, there is significant hydrocarbon contamination in the intermediate silt and sand layers, as well as in the overlying A

Clay and the underlying Main Sand. More specifically:

- There is an area of residual-phase LNAPL contamination in the A Clay within 4-10 feet of the ground surface just northwest of the Community Center. (Pl. Ex. 199 at EPA_RPT026174-75, 199).

- In the relatively near-surface North Olive stratum, there is a mixture of gasoline-range and diesel-range residual-phase contamination southwest of the property, near the intersection of West Arbor Street and Old St. Louis Road, and there is diesel-range residual-phase LNAPL contamination just northwest of the Community Center. (Pl. Ex. 199 at EPA_RPT026175, 200).

- At greater depth in the Rand stratum, there is a combination of gasoline-range and diesel-range residual-phase contamination to the southwest, near the intersection of West Arbor Street and Old St. Louis Road, and there is diesel-range residual-phase contamination just southeast of the Community Center. (Pl. Ex. 199 at EPA_RPT026175-76, 201).

- In the EPA stratum and the Main Sand near the Community Center, there is: (I) mixed gasoline-range and diesel range LNAPL to the northeast and southwest; (ii) diesel-range LNAPL, as well as mixed heavy-range and diesel-range LNAPL, to the northwest; and (iii) diesel-range LNAPL to the south and east. (Pl. Ex. 199 at EPA_RPT026203, 205). There is free-phase LNAPL in the Main Sand to the south and west of the Community Center building, and residual-phase LNAPL in the other surrounding areas. (Pl. Ex. 199 at EPA_RPT026177-78, 198, 237).

XXVIII. Residential Air Monitoring Data

300. As part of the In-Home Interim Measures program, the Hartford Working Group has performed periodic indoor and sub-slab sampling in many homes in North Hartford. Although most of that data set reflects results obtained since in-home mitigation measures have been installed in those homes (and the impact of the expanded area-wide Vapor Control System), certain information in that residential data set provides strong evidence of the serious risks of hydrocarbon

vapor intrusion into Hartford homes, as summarized below. (Def. Ex. 1115, 1116).

301. In a number of cases, the vapors beneath the basement foundation have equaled or exceeded 10% of the lower explosive limit.

Address	Date	% LEL (Sub-Slab)	Sources
101 East Birch	4/6/06	Over Range	Def. Ex. 1116 at 2.
101 East Birch	7/6/06	18%	Def. Ex. 1116 at 2.
107 West Birch	10/10/05	62%	Def. Ex. 1116 at 7.
119 West Date	5/2/07	90%	Def. Ex. 1116 at 19.
119 West Date	5/14/07	Over Range	Def. Ex. 1116 at 19.
309 North Olive	5/18/05	67%	Def. Ex. 1116 at 45.
309 North Olive	9/13/05	Over Range	Def. Ex. 1116 at 46.
309 North Olive	11/9/05	Over Range	Def. Ex. 1116 at 46.
309 North Olive	12/20/05	Over Range	Def. Ex. 1116 at 46.
309 North Olive	1/19/06	Over Range	Def. Ex. 1116 at 44.
309 North Olive	2/6/06	17%	Def. Ex. 1116 at 44.
504 North Delmar	7/30/07	11%	Def. Ex. 1116 at 48.
504 North Delmar	9/4/07	10%	Def. Ex. 1116 at 48.
507 North Olive	5/17/05	62%	Def. Ex. 1116 at 48.
507 North Olive	4/2/07	Over Range	Def. Ex. 1116 at 48.
610 Old St. Louis	4/25/05	11%	Def. Ex. 1116 at 50.

Readings designated as “over range” exceeded 100% of the lower explosive limit and

were so high that they were beyond the reading capabilities of the detection instrument. (Cahnovsky Test. Day 3 at 88).

302. In some other cases, very high sub-slab levels of benzene and other gasoline constituents have been documented, although the LEL readings were lower.

Address	Date	Benzene ($\mu g/m^3$)	Hexane ($\mu g/m^3$)	Isopentane ($\mu g/m^3$)	% LEL	Sources
310 North Delmar	3/15/05	120,000	480,000	7,900,000	0%	Def. Ex. 1116 at 46.
310 North Delmar	4/28/05	110,000	210,000	1,600,000	0%	Def. Ex. 1116 at 47.
504 North Delmar	8/6/07	18,000	78,000	430,000	9%	Def. Ex. 1116 at 48.
504 North Delmar	8/13/07	6,100	37,000	220,000	7%	Def. Ex. 1116 at 48.
504 North Delmar	8/27/07	2,600	31,000	240,000	5%	Def. Ex. 1116 at 48.
504 North Delmar	9/10/07	1,000	37,000	260,000	5%	Def. Ex. 1116 at 48.

303. Contemporaneous indoor and sub-slab readings in several homes offer clear evidence of vapor intrusion. High sub-slab levels caused elevated levels in the basement on the same day, and somewhat lower (but still elevated) levels on the first floor.

		Isopentane Concentration ($\mu g/m^3$)			
Address	Date	1st Floor	Basement	Sub-Slab	Sources
119 West Date	5/2/07	160	190	4,200,000	Def. Ex. 1115 at 24; Def. Ex. 1116 at 19.
119 West Date	5/14/07	2,500	13,000	17,000,000	Def. Ex. 1115 at 24; Def. Ex. 1116 at 19.
309 North Olive	5/18/05	11	430	9,400,000	Def. Ex. 1115 at 57; Def. Ex. 1116 at 45.
309 North Olive	9/13/05	93	330	9,200,000	Def. Ex. 1115 at 58; Def. Ex. 1116 at 46.
309 North Olive	11/9/05	58	100	4,400,000	Def. Ex. 1115 at 58; Def. Ex. 1116 at 46.
309 North Olive	12/20/05	200	270	24,000,000	Def. Ex. 1115 at 58; Def. Ex. 1116 at 46.
309 North Olive	1/19/06	130	300	20,000,000	Def. Ex. 1115 at 57; Def. Ex. 1116 at 44.
310 North Delmar	3/15/05	130	130	7,900,000	Def. Ex. 1115 at 59; Def. Ex. 1116 at 46.
310 North Delmar	4/28/05	44	61	1,600,000	Def. Ex. 1115 at 59; Def. Ex. 1116 at 47.
504 North Delmar	7/30/07	15	20	640,000	Def. Ex. 1115 at 62; Def. Ex. 1116 at 48.
504 North Delmar	8/27/07	180	190	240,000	Def. Ex. 1115 at 62; Def. Ex. 1116 at 48.
507 North Olive	5/17/05	20	33	1,500,000	Def. Ex. 1115 at 63; Def. Ex. 1116 at 48.
507 North Olive	12/5/05	110	170	66,000	Def. Ex. 1115 at 63; Def. Ex. 1116 at 49.
507 North Olive	4/2/07	51	520	33,000,000	Def. Ex. 1115 at 62; Def. Ex. 1116 at 48.

304. In some cases, there is no contemporaneous sub-slab data that can be

used for comparison, but the high levels in the basement (and somewhat lower levels on the first floor) constitute strong evidence of vapor intrusion.

		Isopentane Concentration ($\mu g/m^3$)		Hexane Concentration ($\mu g/m^3$)		
Address	Date	1st Floor	Basement	1st Floor	Basement	Sources
101 East Birch	8/17/04	2,000	14,000	120	910	Def. Ex. 1115 at 2.
129 West Birch	3/10/04	27,000	50,000	2,800	5,700	Def. Ex. 1115 at 41, 42.
130 East Watkins	6/8/04	Not sampled	11,000	Not sampled	730	Def. Ex. 1115 at 42.
134 East Watkins	6/8/04	820	3,800	110	560	Def. Ex. 1115 at 46.
134 East Watkins	1/19/05	5,100	8,500	890	1,600	Def. Ex. 1115 at 46.
310 North Delmar	6/1/04	Not sampled	10,000	Not sampled	600	Def. Ex. 1115 at 59.
310 North Delmar	1/5/05	Not sampled	5,600	Not sampled	240	Def. Ex. 1115 at 60; Def. Ex. 1033 at 6.
310 North Delmar	2/15/05	1,100	2,300	58	120	Def. Ex. 1115 at 58.

305. The high hydrocarbon levels that were detected in those homes cannot be attributed to "background levels" or indoor sources. For example, as noted in the report prepared by one of Defendant's expert witnesses, background concentrations of hexane in indoor air typically are between 0.63 and 6.4 $\mu g/m^3$, and hexane is not prevalent in consumer products (other than gasoline, quick drying glues, and rubber

cement). (Def. Ex. 787 at 65, 73 (Tables 13, 16)).

XXIX. Residential Case Studies

306. As described in the five case studies presented below, many of the homes that have had recent problems with vapor intrusion and high sub-slab hydrocarbon gas levels also have a well-documented history of earlier vapor intrusion problems.

A. Case Study 1: A Home on East Watkins Street in the Southernmost Part of North Hartford

307. Marcie and Virgil Ellis are a couple in their 30s with two children. They live at 134 East Watkins Street, in the southernmost part of North Hartford. (Cahnovsky Test. Day 3 at 102). The Ellis' family pet is a large dog. (Cahnovsky Test. Day 3 at 105).

308. The residents of this home on East Watkins Street were among dozens of homeowners in North Hartford who registered hydrocarbon odor complaints in March 1978. (Pl. Ex. 191 at EPA_RPT 022282-84). The home's residents also joined many others who made odor complaints in late April 1993. (Pl. Ex. 191 at EPA_RPT 022289-90). There have been fires in four other homes on East Watkins Street (one in 1975 and three in 1979). (Pl. Ex. 151 at APEXDEPO_004833; Pl. Ex. 191 at EPA_RPT 022289-91).

309. Since May of 2002, the current homeowners have had to leave their home on multiple occasions due to hydrocarbon vapor intrusion. (Cahnovsky Test. Day 3 at 104, 105, 110, 112). On at least one of those occasions, the family needed

to leave its pet dog in the home when they evacuated, because the hotels that were used for voluntary relocation would not allow larger pets. (Cahnovsky Test. Day 3 at 105).

310. The residents of this home were among the families who experience the severe vapor intrusion event on East Watkins Street in mid-May 2002. As noted above, homes on the street had indoor benzene levels as high as 330 ppb (approximately 1,064 $\mu g/m^3$) and hexane levels as high as 12,218 ppb (approximately 43,007 $\mu g/m^3$) during that incident. (Pl. Ex. 321 at APEXDEPO_001312).

311. Two years after the May 2002 incident, the family needed to vacate their home due to hydrocarbon vapor intrusion problems on May 30 and June 7, 2004. (Cahnovsky Test. Day 3 at 103-105; Pl. Ex. 378 at IEPA001162-63). Sampling that Illinois EPA performed on June 7 yielded clear evidence of ongoing hydrocarbon vapor intrusion based on a reading at 6% of the lower explosive limit in a crack in the basement floor. (Pl. Ex. 378 at IEPA001162-64). Summa canister samples taken in the home on June 8, 2004 also showed elevated levels of gasoline constituents in the home (with higher levels in the basement and lower levels on the first floor).

		Isopentane ($\mu g/m^3$)	Hexane ($\mu g/m^3$)	Source
6/8/04	1st Floor	820	100	Def. Ex. 1115 at 46
	Basement	3,800	550	

312. In response to those problems, a contractor for the Hartford Working Group performed a needs assessment in the home and took steps such as sealing

cracks in the walls and cement floors, sealing dirt floor areas in a crawl space and in a basement storage room with plastic sheeting, and installing a ventilation fan in the basement storage room. Once those mitigation measures were completed in mid-June 2004, the family members returned to their home. (Cahnovsky Test. Day 3 at 105-08; Pl. Ex. 378 at IEPA001162-64).

313. After several days of heavy rainfall in the area, vapor intrusion problems once again forced the family to leave their home on June 21, 2004. (Pl. Ex. 378 at IEPA001164-65, 1168). Illinois EPA and the Hartford Fire Department responded to the homeowners' complaint, confirmed the presence of petroleum odors inside the home, and performed air monitoring with field instruments. (Cahnovsky Test. Day 3 at 105-110; Pl. Ex. 378 at IEPA001164-65). Although the newly-installed ventilation fan had been running in the basement storage room, combustible gas meter readings taken by Illinois EPA still detected hydrocarbon gases at 1% of the lower explosive limit in the ambient air in that room and at 33% and 16% of the lower explosive limit at two different points under the plastic sheeting covering the dirt floor area. (Cahnovsky Test. Day 3 at 106-08; Pl. Ex. 378 at IEPA001164-65). When firefighters removed that plastic sheeting, they also measured gases at 25% of the lower explosive limit. (Pl. Ex. 378 at IEPA001164-65). In response to those readings, the fire department ventilated the home thoroughly for 45 minutes, using a specialized ventilation fan. (Cahnovsky Test. Day 3 at 108-110; Pl. Ex. 378 at IEPA001164-65; Pl. Demo. Ex. 532; Pl. Demo. Ex. 533). Even after that ventilation, there still was a noticeable petroleum odor in the basement storage room.

(Pl. Ex. 378 at IEPA001165).

314. In the days following the June 21 incident, the Hartford Working Group's contractor took additional steps to try to limit vapor intrusion into the home, including painting the basement walls with sealant paint, sealing more floor cracks, plugging an unused basement floor drain, and pouring a new concrete floor in the basement storage room. Once again, the family returned to their home after that work was done. (Cahnovsky Test. Day 3 at 111; Pl. Ex. 378 at IEPA001165-66).

315. In early January 2005, there was a rapid rise in the water level in the Mississippi River near the Site, and a corresponding rise in groundwater levels beneath the Village. (Pl. Ex. 200 at EPA_RPT041435-36). During the same time frame, the Hartford Working Group performed soil vapor sampling at monitoring point VMP-81 on East Watkins Street, as part of its larger Site-wide soil vapor study. (Pl. Ex. 177 at EPA_RPT001426, 1435; Pl. Demo. Ex. 642 (depicting VMP-81's location on East Watkins Street)). That monitoring showed a significant increase in hydrocarbon vapor levels in shallow and very shallow soils beneath East Watkins Street between January 6 and January 12, 2005.

	Sample Date	Isopentane Concentration ($\mu g/m^3$)	Hexane Concentration ($\mu g/m^3$)	Benzene Concentration ($\mu g/m^3$)
VMP-81VS (very shallow)	1/6/05	2,500,000	690,000	3,200
	1/12/05	51,000,000	13,000,000	2,700,000
VMP-81S (shallow)	1/6/05	29,000,000	7,500,000	1,100,000
	1/12/05	50,000,000	12,000,000	2,400,000
Source: Pl. Ex. 177 at EPA_RPT 001435.				

316. Just as those near-surface soil vapor levels were increasing, the family again experienced vapor intrusion problems, and they left their home and stayed in a hotel arranged by the Hartford Working Group on January 18, 2005. (Pl. Ex. 377 at IEPA001156). An Illinois EPA employee who visited the home smelled gasoline odors in the living room and in the basement. Contractors for the Hartford Working Group measured hydrocarbon gases at 4% of the lower explosive limit coming from a previously-sealed crack in the basement floor. (Cahnovsky Test. Day 3 at 111-15; Pl. Ex. 377 at IEPA001156-57). Despite all the prior work that had been done to try to limit vapor intrusion into the home, summa canister sampling on January 19, 2005 yielded hydrocarbon readings that were even higher than those in June 2004.

		Isopentane ($\mu g/m^3$)	Hexane ($\mu g/m^3$)	Source
1/19/05	1st Floor	5,100	890	Def. Ex. 1115 at 46
	Basement	8,500	1,600	

On January 20, the contractor's employees again smelled hydrocarbon odors in the home and found other unsealed cracks that had either been missed or formed after their prior sealing efforts. (Cahnovsky Test. Day 3 at 114-15; Pl. Ex. 374 at IEPA001143; Pl. Ex. 377 at IEPA001157, 1161).

317. Given the recurrent vapor intrusion problems at the home, the Hartford Working Group finally installed a sub-slab depressurization system for the home in early 2005, at the insistence of U.S. EPA and Illinois EPA. (Cahnovsky Test. Day 3 at 115-17; Pl. Ex. 373; Pl. Ex. 374 at IEPA001143). Limited indoor air monitoring in the home since then (in March and December 2005) disclosed no signs of significant vapor intrusion, but experience at the Hartford Site has shown that sub-slab depressurization systems are not good for vapor intrusion mitigation on a long-term basis because such systems are difficult to operate and maintain, and they can be problematic. (Def. Ex. 1115 at 46; Cahnovsky Test. Day 3 at 117-18, 126-132).

318. The ROST study that was done at the Hartford Site confirmed the presence of residual-phase hydrocarbon contamination in the silty-clay and sand strata beneath East Watkins Street. (Pl. Ex. 199 at EPA_RPT026243 (indicating a positive ROST response at and between monitoring points HROST-50, HROST-51, and HROST-52 on East Watkins Street); Pl. Demo. Ex. 506 (showing that the contamination along East Watkins Street likely is residual-phase LNAPL, rather than free-phase LNAPL); Pl. Demo. Ex. 642). Many of the homes along East Watkins Street sit in shallow fill and the near-surface A Clay stratum, with their basements located just a few feet above that residual-phase contamination in the silty-clay and

sand strata. (Pl. Ex. 199 at EPA_RPT026243). That residual-phase contamination can serve as a long-term source of vapor-phase hydrocarbons. (Howe Test. Day 6 at 63-64).

B. Case Study 2: A Home on Birch Street in the Northernmost Part of North Hartford

319. Lonnie and Sherry Bishop reside at 101 East Birch Street, in the northeast portion of North Hartford. (Cahnovsky Test. Day 3 at 134).

320. There was a basement fire in this home on Birch Street on May 19, 1990, within days of four other house fires and dozens of odor complaints in North Hartford in late May 1990. (Pl. Ex. 191 at EPA_RPT022288, 289, 291; Def. Ex. 167).

321. The homeowners contacted Village officials and registered another hydrocarbon odor complaint in February 1991. (Pl. Ex. 191 at EPA_RPT022289).

322. The Illinois Department of Public Health performed quarterly indoor air sampling in the home between June 2003 and May 2004. That sampling generally showed elevated levels of various petroleum constituents in the basement, and somewhat lower levels on the first floor.

		Isopentane ($\mu g/m^3$)	Hexane ($\mu g/m^3$)	Benzene ($\mu g/m^3$)	Sources
6/19/03	1st Floor	109.73	3.51	2.97	Pl. Demo. Ex. 675 at 3; Pl. Demo. Ex. 679
	Basement	432.59	6.59	2.85	
9/18-19/03	1st Floor	1,457.35	72.54	8.50	Pl. Demo. Ex. 679; Def. Ex. 864 at 3
	Basement	4,603.83	223.55	11.97	
1/22/04	1st Floor	18.84	3.36	2.11	Pl. Demo. Ex. 677 at 3; Pl. Demo. Ex. 679
	Basement	56.38	3.21	2.10	
5/14/04	1st Floor	1,440.17	26.81	4.77	Pl. Demo. Ex. 678 at 3; Pl. Demo. Ex. 679
	Basement	2,625.80	60.32	6.06	

323. In August 2004, a contractor for the Hartford Working Group performed additional indoor air sampling at the home, as part of an initial needs assessment under the In-Home Interim Measures program. (Cahnovsky Test. Day at 135; Pl. Ex. 372 at IEPA001127). The results of that sampling showed especially high hydrocarbon levels, including benzene in the basement at twice the health-based acute comparison value (at 58 $\mu g/m^3$, versus the 29 $\mu g/m^3$ comparison value) established by the federal and state agencies under the Effectiveness Monitoring Plan and hexane at four and one-half times the comparison value for theat substance (at 910 $\mu g/m^3$, versus the 200 $\mu g/m^3$ comparison value). (Pl. Ex. 250 at EPA_RPT035093).

		Isopentane (μg/m^3)	Hexane (μg/m^3)	Benzene (μg/m^3)	Sources
8/17/04	1st Floor	2,000	120	< 23 U	Def. Ex. 1115 at 2
	Basement	14,000	910	58	

324. The "U" qualifier for the first floor benzene result signifies that benzene was not quantified above the detection limit for that sample. (Def. Ex. 1115 at 2, 66). In such cases, the reported numerical value is the benzene detection limit for the particular sample. As prescribed by U.S. EPA data quality assurance guidance documents,"U" qualified values can be reported and treated in that manner, or they can be reported at one-half of the detection limit, if there is reason to believe that the sample actually contained the compound, but that it was not detected due to the comparatively large amounts of other hydrocarbon compounds. (Weis Test. Day 5 at 19-22; Def. Ex. 787 at 10). In this instance, the first floor results for benzene were "U" qualified but the basement results were not. (Def. Ex. 1115 at 2).

325. Based on the needs assessment that was completed for the home, the Hartford Working Group's contractor installed a mitigation package at the home, which included installing a vent fan, sealing all floor and wall cracks, unused floor drains, and utility conduits, and repairing a broken sewer pipe and installing a gate valve in the sewer line. (Cahnovsky Test. Day 3 at 136; Pl. Ex. 372 at IEPA001127). The broken sewer pipe was the result of the homeowners' attempt to prevent water from entering their basement during wet weather. (Cahnovsky Test. Day 3 at 136).

326. Despite the repairs and sealing work, the homeowners continued to have

problems with water entering their basement, so they hired a firm to install a sump pump in December 2004. That required the contractor to cut through the basement floor and dig a hole for the sump. After that had been done, the contractor and the homeowner smelled very strong hydrocarbon odors coming from the sump. (Cahnovsky Test. Day 3 at 136-137; Pl. Ex. 237 at APEX001129-30, 1137).

327. At that point, the homeowners registered another odor complaint, and representatives of Illinois EPA and a contractor for the Hartford Working Group visited the home on December 9, 2004. (Cahnovsky Test. Day 3 at 136-137; Pl. Ex. 237 at APEX001129, 1137). Air monitoring that they performed with handheld photo ionization detector ("PID") and flame ionization detector ("FID") equipment showed high hydrocarbon levels in the ambient air in the basement and particularly high levels in the basement sump pit. (Cahnovsky Test. Day 3 at 137; Pl. Ex. 237 at APEX001129-30). Illinois EPA and the Hartford Working Group's contractor also measured hydrocarbons in the sump pit at 4% of the lower explosive limit. (Pl. Ex. 237 at APEX001129-30; Def. Ex. 1115 at 2). Summa canister samples that were analyzed later also showed isopentane gas in the sump at 140,000 $\mu g/m^3$ and isopentane levels as high as 16,000,000 $\mu g/m^3$ in samples taken from sub-slab monitoring ports. (Def. Ex. 1115 at 2; Def. Ex. 1116 at 2). Based on the high LEL and FID readings, Illinois EPA contacted the Hartford Fire Department, which responded by ventilating the home. (Cahnovsky Test. Day 3 at 137; Pl. Ex. 237 at APEX001129-30). The homeowners agreed to be relocated to a hotel for the evening, due to persisting odors and concern that hydrocarbon vapor levels in the home could

increase until the sump was sealed. (Cahnovsky Test. Day 3 at 137; Pl. Ex. 237 at APEX001130, 1137, 1141-42).

328. The Hartford Working Group's contractor temporarily sealed the basement sump pit and re-sampled it the next day, on December 10, 2004. (Pl. Ex. 237 at APEX001130). Those samples from inside the sump pit showed even higher levels of hydrocarbon gases than the day before, including isopentane at 1,700,000 $\mu g/m^3$ and hexane at 24,000 $\mu g/m^3$. (Def. Ex. 1115 at 2).

329. About a month later, in January 2005, soil vapor sampling was done at a set of nested monitoring points located on the street adjacent to the home, as part of the Hartford Working Group's comprehensive soil vapor study of the Site. That monitoring showed extremely high levels of hydrocarbon gases at all depths that were sampled, from just below basement levels all the way down to the Main Sand stratum. (Pl. Demo. Ex. 673).

Monitoring Point	Well Screening Depth	Isopentane Concentration ($\mu g/m^3$)	Sample Date
MP-29A	10.10-12.10 feet below ground surface	39,000,000	1/26/05
MP-29B	15.50-20.50 feet below ground surface	44,000,000	1/12/05
MP-29C	21.60-28.30 feet below ground surface	20,000,000	1/12/05
MP-29D	31.50-41.20 feet below ground surface	1,100,000,000	1/26/05
Source: Pl. Demo. Ex. 673 at 5 (and the primary sources cited therein)			

330. At U.S. EPA's and Illinois EPA's insistence, the Hartford Working Group installed a new sealed sump with an explosion-proof sump pump and an entire sub-slab depressurization system for the home by the end of January 2005. (Cahnovsky Test. Day 3 at 139; Pl. Ex. 237 at APEX001130; Pl. Ex. 370; Pl. Ex. 374 at IEPA001144-45).

331. Although quarterly monitoring has shown no evidence of serious vapor intrusion into the home since the sub-slab depressurization system was installed, the sub-slab monitoring has continued to show elevated hydrocarbon levels beneath the home. On April 6, 2006 the sub-slab lower explosive limit readings were "over range" for the combustible gas meter and the isopentane levels were at 18,000,000 $\mu g/m^3$. On July 6, 2006, the sub-slab gas levels were at 18% of the lower explosive limit and

isopentane was measured at 16,000 $\mu g/m^3$. On June 13, 2007, isopentane beneath the home was measured at 20,000 $\mu g/m^3$. (Def. Ex. 1116 at 2).

332. Like other areas in the northernmost part of North Hartford (such as the Community Center property), the geology and pattern of subsurface contamination near this home on Birch Street are particularly complex.

333. The soils beneath the home include several intermediate silt, silty-clay, and sand layers (i.e., the North Olive silt stratum, the B Clay, the Rand silt stratum, the C Clay, the EPA sand stratum, and the D Clay). (Pl. Ex. 199 at EPA_RPT026264-76).

334. There is significant hydrocarbon contamination in the intermediate silt and sand layers near the home, as well as in the overlying A Clay and the underlying Main Sand. More specifically:

- To the east and northeast of the home, there is residual-phase diesel-range and heavy-range LNAPL contamination in the A Clay within 4-10 feet of the ground surface. (Pl. Ex. 199 at EPA_RPT026174-75, 199). That contamination extends downward through the North Olive stratum, the Rand stratum, and the EPA and Main Sand strata. (Pl. Ex. 199 at EPA_RPT026200, 201, 203).

- Just south and southwest of the home, there is residual-phase diesel-range and gasoline-range LNAPL contamination within 10-20 feet of the ground surface. (Pl. Ex. 199 at EPA_RPT026174-75, 199). That contamination extends down to the EPA and Main Sand strata. (Pl. Ex. 199 at EPA_RPT026200, 201, 203).

- There is free-phase LNAPL contamination in the Main Sand beneath the home. (Pl. Ex. 199 at EPA_RPT026198, 237).

C. Case Study 3: A Home on North Delmar Avenue in the South Central Part of North Hartford

335. Mike and Linda Hanbaum are a young married couple who own the home at 310 North Delmar Avenue. (Cahnovsky Test. Day 3 at 118-119). The Hanbaums bought that home in 2000. (Pl. Ex. 366 at IEPA001103).

336. There are no documented odor complaints regarding this home before 2000, although there were complaints at several other locations within a block of the residence in 1978, 1979, 1990, 1991, and 1993. (Pl. Ex. 191 at EPA_RPT022282-290).

337. The homeowners contacted state and local authorities about odor problems on three separate occasions in 2003 and January 2004, and vapor intrusion problems caused them to leave their home on five separate occasions since March 2004. (Pl. Ex. 368; Pl. Ex. 264; Def. Ex. 205; Def. Ex. 206; Def. Ex. 207; Cahnovsky Test. Day 3 at 119-122, 127-28, 132).

338. The Hartford Working Group's contractor performed an initial needs assessment in the home in March 2004, when the homeowners were relocated to a hotel in response to elevated hydrocarbon gas levels that Illinois EPA measured in the game room and the basement in their home. (Cahnovsky Test. Day 3 at 119-120; Pl. Ex. 366 at IEPA001099, 1103; Pl. Ex. 367 at IEPA001111-12). Illinois EPA received reports that at least seven other homes in North Hartford had similar gas odor problems between March 4 and March 22, 2004. (Pl. Ex. 234 at APEX001125-26).

339. On April 16, 2004, the Hartford Working Group's contractor placed plastic sheeting over dirt floor areas in the home's basement, to serve as a temporary vapor barrier. (Cahnovsky Test. Day 3 at 120; Pl. Ex. 365 at IEPA001096). Less than a week later, the homeowners again contacted Illinois EPA and the Hartford Fire Department about hydrocarbon odors in their home. (Cahnovsky Test. Day 3 at 120-121). Although the homeowner had opened the doors and windows on the first floor and in the basement and was ventilating the home with multiple box fans, there was still a noticeable petroleum odor and a contractor for the Hartford Working Group measured hydrocarbons at 1% of the lower explosive above the plastic sheeting that had been placed over the dirt floor areas in the basement. (Pl. Ex. 364 at IEPA001093). The Fire Department also measured hydrocarbon gases at 12% of the lower explosive limit underneath the plastic sheeting in the basement. (Pl. Ex. 364 at IEPA001093; Pl .Ex. 365 at IEPA001096). In response to those readings, the homeowners were evacuated by the Hartford Fire Department and they were provided lodging in a local hotel by the Hartford Working Group. (Pl. Ex. 365 at IEPA001096; Cahnovsky Test. Day 3 at 121).

340. As a temporary mitigation measure, the Hartford Working Group's contractor installed an exhaust fan in the home's basement in early May 2004. (Pl. Ex. 366 at IEPA001099; Pl. Ex. 365 at IEPA001096). The homeowners left their home and stayed in a hotel again in late May after complaining of headaches caused by odors in their home. Monitoring with PID/FID equipment showed high hydrocarbon vapor levels underneath the plastic sheeting covering the dirt floor areas

in their basement. (Pl. Ex. 363 at IEPA001086, 1089; Cahnovsky Test. Day 3 at 122).

341. Follow-up sampling that was performed a few days later, on June 1, 2004, confirmed an ongoing vapor intrusion problem, with high levels of gasoline constituents in the home's basement.

	Location	Isopentane ($\mu g/m^3$)	Hexane ($\mu g/m^3$)	Benzene ($\mu g/m^3$)
6/1/04	Basement (East)	6,800	260	6.2
	Basement (West)	10,000	420	18
Source: Def. Ex. 1115 at 59				

Samples were not taken on the first floor that day. (Def. Ex. 1115 at 59).

342. The Hartford Working Group ultimately completed a much more robust set of mitigation measures for the home, including sealing cracks in the walls and the existing concrete floor areas in the basement, replacing the dirt floor areas in the basement with a new concrete floor, and installing a sub-slab depressurization system. (Pl. Ex. 366 at IEPA001099-1100; Cahnovsky Test. Day 3 at 123-25).

343. On December 1, 2004, gases in the basement sump were measured at 12% of the lower explosive limit and air samples that were collected from the sump contained very high levels of gasoline constituents (including isopentane at 4,100,000 $\mu g/m^3$ and hexane at 300,000 $\mu g/m^3$). (Def. Ex. 1115 at 59).

344. While Mississippi River levels and groundwater levels in North Hartford were rising rapidly in early January 2005, the Hartford Working Group's contractor took additional air samples inside the home in response to renewed odor complaints.

(Pl. Ex. 200 at EPA_RPT041435-36; Def. Ex. 1115 at 60; Pl. Ex. 364 at IEPA 001092-93) . The results of that sampling indicated that there was a persisting vapor intrusion problem at the home, despite the enhanced interim measures.

	Location	Isopentane ($\mu g/m^3$)	Hexane ($\mu g/m^3$)	Benzene ($\mu g/m^3$)
1/5/05	Basement (General Area)	5,600	240	5
	Basement (General Area Near Su mp)	4,800	230	4.5
Sources: Def. Ex. 1115 at 60; Def Ex. 1033 at 6				

345. As in other parts of North Hartford, soil vapor monitoring that was performed near the home for the Site-wide soil vapor study showed marked increases in sub-surface hydrocarbon vapor concentrations during January 2005.

	Sample Date	Isopentane Concentration ($\mu g/m^3$)	Hexane Concentration ($\mu g/m^3$)	Benzene Concentration ($\mu g/m^3$)
VMP-69VS (very shallow)	1/10/05	20,000,000	1,200,000	32,000
	1/19/05	62,000,000	3,100,000	24,000
VMP-69M (medium depth)	1/10/05	62,000,000	3,500,000	1,200,000
	1/19/05	110,000,000	5,800,000	2,000,000
VMP-69D (deep)	1/10/05	68,000,000	3,600,000	1,300,000
	1/19/05	130.000,000	6,800,000	2,600,000
Sources: Pl. Ex. 177 at EPA_RPT 001431; Pl. Demo Ex. 672 (showing the location of VMP-69, about half a block from the home)				

346. By late January 2005, the Hartford Working Group's contractor informed U.S. EPA and Illinois EPA that the sub-slab depressurization system at the home was not working as effectively as it should because water under the slab was getting into the system. The contractor also indicated that plans were being made to install a new sealed and explosion proof sump pump in the home. (Pl. Ex. 374 at IEPA001143; Cahnovsky Test. Day 3 at 126-27).

347. The homeowners again complained of hydrocarbon odors in their home on February 15, 2005, after returning from a vacation. (Pl. Ex. 360 at IEPA001059-60, 62; Cahnovsky Test. Day 3 at 127-28). The Hartford Working Group's contractor tested the sub-slab depressurization system and concluded that it was working properly. (Pl. Ex. 360 at IEPA001062). The contractor also collected several indoor

air samples that day using summa canisters. (Def. Ex. 1115 at 58). A later analysis of those samples indicated that there had been elevated hydrocarbon levels in the home, even though the sub-slab depressurization system seemed to be operating properly.

	Location	Isopentane (μg/m^3)	Hexane (μg/m^3)	Benzene (μg/m^3)
2/15/05	1st Floor	1,100	58	< 3.8 U
	Basement	2,300	120	< 11 U
Source: Def. Ex. 1115 at 58.				

348. The homeowners complained of odors again a few days later, on February 19, 2005. Using handheld field equipment, the Hartford Working Group's contractor detected highly-elevated hydrocarbon vapor levels in the basement near the home's sump pump. The contractor also re-tested the home's sub-slab depressurization system and determined that on that day it was not creating a vacuum to draw vapors from beneath the home, as intended. (Pl. Ex. 360 at IEPA001059, 1062). The homeowners again left home and stayed in a hotel while adjustments were made to the sub-slab depressurization system over the next few days. (Pl. Ex. 360 at IEPA001059, 1062; Cahnovsky Test. Day 3 at 127-28).

349. A major problem with the homes' sub-slab depressurization system was discovered on March 15, 2005, as a contractor for the Hartford Working Group was making further adjustments to the system. Hydrocarbon gases that were being exhausted from the system's vent stack were causing a noticeable smell in the area

around the home, including in a neighbor's yard and on the neighbor's porch. The owner of that home smelled the vapors, became upset, and was taken by ambulance to the hospital after complaining of shortness of breath and chest pain. The Hartford Working Group's contractor tested the vapors exiting the exhaust stack just above the home's roof line and determined that the gas contained hydrocarbons at 100% of the lower explosive limit. (Cahnovsky Test. Day 3 at 128-133; Pl. Ex. 361; Pl. Ex. 362 at IEPA001069-70).

350. Sub-slab monitoring beneath the home that day also disclosed extraordinarily high levels of hydrocarbons.

	Location	Isopentane ($\mu g/m^3$)	Hexane ($\mu g/m^3$)	Benzene ($\mu g/m^3$)
3/15/05	Sub-Slab (Port 4)	7,900,000	480,000	120,000
Source: Def. Ex. 1116 at 46.				

351. The residents of both homes left their homes for several weeks in late March and early April 2005, as the Hartford Working Group's contractor made more adjustments to the sub-slab system and evaluated other options for controlling vapors beneath the home (including installation of new soil vapor extraction wells near the home). (Cahnovsky Test. Day 3 at 131-32; Pl. Ex. 362 at IEPA001070-72).

352. By late April 2005, the Hartford Working Group had completed installation of two new soil vapor extraction wells near the home, and the home's sub-slab depressurization system was shut down. (Cahnovsky Test. Day 3 at 131-32;

Pl. Ex. 177 at EPA-RPT001362).

353. Since April 2005, periodic monitoring at the home still has shown some elevated hydrocarbon levels in indoor and sub-slab samples, which are symptomatic of vapor intrusion.

	Location	Isopentane (μg/m^3)	Hexane (μg/m^3)	Benzene (μg/m^3)
3/12/07	Basement	63	10	5.3
3/12/07	Sub-Slab (Port 4)	4,800	900	240
Sources: Def. Ex. 1115 at 58; Def. Ex. 1116 at 46.				

354. The home is located in an area with an especially thin layer of silty-clay at the surface which lies immediately atop the Main Sand stratum. In fact, the basement of the home probably sits no more than three feet above the Main Sand. (Pl. Ex. 362 at IEPA001070; Pl. Demo. Ex. 672 (showing the home's proximity to ROST sampling point HROST-37); Pl. Demo Ex. 671 (showing the geologic stratigraphy at and near HROST-37)). The ROST study found extensive hydrocarbon contamination in the Main Sand in the area near the home. (Pl. Demo Ex. 506; Pl. Demo. Ex. 671; Pl. Ex. 194 at EPA_RPT 036004, 36192 (showing a strong positive ROST response for hydrocarbons at HROST-37)). There also is extensive contamination near the home along Elm Street, where the River Lines were located. For example, at ROST sampling point HROST-116, the soils are heavily contaminated with both free-phase and residual-phase LNAPL, beginning approximately eight feet below the ground surface and extending well into the Main

Sand stratum. (Pl. Demo. Ex. 672 (showing the home's proximity to HROST-116); Pl. Ex. 202 at EPA_RPT042384 (showing a strong positive ROST response for gasoline range hydrocarbons at HROST-116); Howe Test. Day 6 at 25-27, 31-32 (explaining the ROST results at HROST-116)).

D. Case Study 4: A Home on West Date Street in the West Central Part of North Hartford

355. Mabel Edwards is a senior citizen who lives alone at 119 West Date Street. She frequently babysits her grandchildren in her home. (Cahnovsky Test. Day 3 at 76-77). Ms. Edwards rents the home from its owner, Rhonda Robbins. (Cahnovsky Test. Day 3 at 90-92; Def. Ex. 1042).

356. There is a long and well-documented history of vapor intrusion problems at this home on West Date Street. (Turner Test. Day 9 at 199; Pl. Ex. 191 at EPA-RPT022283, 284, 288, 289, 291).

357. There was a fire in the basement of the home in 1973. (Turner Test. Day 9 at 199; Pl. Ex. 191 at EPA_RPT022291; Pl. Ex. 2).

358. There have been at least twenty hydrocarbon odor complaints by residents of the home, including complaints in 1970, 1973, 1978, 1979, 1990, and 2004. (Turner Test. Day 9 at 199-201; Pl. Ex. 176 at EPA_RPT001917; Pl. Ex. 191 at EPA-RPT022283, 284, 288, 289; Def. Ex 586 at 43-49; Def. Ex. 617 at 121, 123).

359. The Hartford Fire Department visited the home in response to many of those odor complaints and detected explosive levels of hydrocarbon gases in the home's basement (at levels as high as 143% of the lower explosive limit). (Turner

Test. Day 9 at 199-201; Pl. Ex. 2; Def. Ex. 617 at 121, 123).

360. The home is located in the area served by the original Vapor Control System that was installed in the early 1990s and upgraded in 2004. In 2004, a soil vapor extraction well for that Vapor Control System was located approximate 30 feet from the home, beneath West Date Street. (Turner Test. Day 9 at 188, 203; Pl. Ex. 358 at EPA_RPT035917).

361. A needs assessment was completed at the home in July 2004, and a mitigation package was installed as an interim measure. The mitigation package included sealing cracks in the walls and floor of the basement and installing a special one-way valve in a basement drain to limit vapor intrusion. (Turner Test. Day 9 at 202-03; Cahnovsky Test. Day 3 at 77, 90-96; Def. Ex. 1042).

362. Soil vapor sampling near the home in January 2005 showed no evidence of near-surface contamination, though it did show very high hydrocarbon vapor concentrations in the Main Sand at deeper levels. That vapor sampling was done at varying depths at a set of nested monitoring points located in the alley just to the north of West Date Street (MP-39A, MP-39B, and MP-39C). (Pl. Ex. 177 at EPA_RPT001362, 1453; Pl. Ex. 251 at EPA_RPT035287). MP-39C is screened in the Main Sand, at a depth of 29.00 to 43.70 feet below ground surface. MP-39B is screened in silt at 23.50 to 26.50 feet below ground surface. MP-39A is screened in silty sand 8.00 to 13.00 feet below ground surface. (Pl. Ex. 197 at EPA_RPT042765)). The deepest probe at that location showed extremely high levels of hydrocarbon vapors in the Main Sand (for example, isopentane was measured at

100,000,000 $\mu g/m^3$), but the shallower probes showed much lower vapor levels in the near-surface soil layers (at MP-39B, isopentane was at 12,000 $\mu g/m^3$ and isopentane was measured at 1,600 $\mu g/m^3$ at MP-39A). (Pl. Ex. 177 at EPA_RPT00 1453).

363. Sub-slab monitoring at the home began in June 2006, and the sub-slab results between June 2006 and February 2007 were low and unremarkable. (Turner Test. Day 9 at 198; Def. Ex. 1116 at 19-20; Pl. Ex. 255 at EPA-RPT035754-55).

364. Despite the interim measures at and near the home, extraordinarily high levels of hydrocarbon vapors were measured in routine quarterly sub-slab monitoring at the home in early May 2007. (Turner Test. Day 9 at 195-96). Isopentane was detected at levels as high as 17,000,000 $\mu g/m^3$ and hexane was detected at up to 1,300,000 $\mu g/m^3$. (Def. Ex. 1116 at 19). Due to the high total hydrocarbon levels, explosivity measurements on the sub-slab vapors were at 90% of the lower explosive limit on May 2, 2007 and they were "over range" (in excess of 100% or above the detection range of the instrument) on May 14, 2007. (Watters Test. Day 4 at 67-68; Turner Test. Day 9 at 196-97; Def. Ex. 1116 at 19; Pl. Ex. 255 at EPA_RPT035754, 35796; Pl. Demo. Ex. 551). Among other things, those extraordinarily high sub-slab hydrocarbon concentrations posed a serious explosion risk and fire risk. (Watters Test. Day 4 at 67-68).

365. The monitoring in early May 2007 also showed that the sub-slab gases beneath the home's basement were making their way into the home, because elevated hydrocarbon levels were detected inside the home. Several gasoline constituents were measured at high levels on the first floor of the home and the same compounds

were measured at even higher levels in the basement. (Def. Ex. 1115 at 24; Pl. Ex. 255 at EPA_RPT035674; Turner Test. Day 11 at 198-200).

		Isopentane ($\mu g/m^3$)	Hexane ($\mu g/m^3$)	Source
5/14/07	1st Floor	2,500	280	Def. Ex. 1115 at 24
	Basement	13,000	1,600	

366. At the recommendation of state and local officials, the woman who lived in the home agreed to leave the home and stay with her daughter until her home was cleared for re-occupancy. (Cahnovsky Test. Day 3 at 77-78, 97-98; Watters Test Day 4 at 65-69; Turner Test. Day 9 at 199; Turner Test. Day 11 at 197-98; Def. Ex. 1065).

367. While the resident was evacuated, daily monitoring in the home was done with handheld field instruments. In doing that monitoring, Illinois EPA and the Hartford Working Group's contractor found that hydrocarbon vapors were entering the home around the special one-way floor drain valve than had been installed as part of the mitigation package for the home in 2004. That valve was replaced with and expandable plug. (Cahnovsky Test. Day 3 at 95-96).

368. Although the vapor intrusion problem at the home was first identified on May 2, 2007, no one knows when the incident first began because sampling was not done at the home between the February and May quarterly monitoring events under the In-Home Interim Measures program. (Turner Test. Day 9 at 198-199; Def. Ex. 1115 at 24; Def Ex. 1116 at 19-20; Pl. Ex. 255 at EPA_RPT035673-74,

35754-55).

369. By late May 2007, the levels of sub-slab and indoor hydrocarbon vapors at the home subsided and returned to the low levels that had been seen before the vapor intrusion incident was discovered in early May. (Turner Test. Day 9 at 202; Def. Ex. 1115 at 24; Def. Ex. 1116 at 19; Pl. Ex. 255 at EPA_RPT035673-74, 35754-55).

370. After the May 2007 vapor intrusion incident at the home, the Hartford Working Group performed a follow-up investigation and prepared a report that identified several factors that had contributed to the problem at that home. (Turner Test. Day 9 at 203-210; Pl. Ex. 251).

371. The report presented the results of geo-probe test borings near the home, which showed that there was a comparatively thin layer of about 5 feet of clayey-silts and silty-clays beneath the home, with more porous sandy layers above and below those less permeable soils. (Turner Test. Day 9 at 204-05; Pl. Ex. 251 at EPA_RPT035287- 290).

372. The report showed that rapidly-rising groundwater levels in the area during late April and early May 2007 had forced hydrocarbons in the Main Sand stratum up through the relatively thin layer of clays and silts beneath the home. (Turner Test. Day 9 at 204-05, 209-210; Pl. Ex. 251).

373. The report also showed that groundwater levels at the monitoring well closest to the home rose a total of 3.56 feet during April and May 2007, with the most significant daily rises in groundwater levels occurring within days of the vapor

intrusion incident, April 28 and May 10. (Turner Test. Day 9 at 208-09; Pl. Ex. 251 at EPA_RPT035292, 35296).

374. The report presented monitoring probe data which showed that pressure build-up from the groundwater rise in the Main Sand stratum forced gases upward into shallower soil layers near the home. The data indicated that the upward migration of vapors could not be controlled or captured by the existing Vapor Control System because the positive pressure exerted by the rising groundwater overwhelmed the negative pressure created by soil vapor extraction wells in the area. (Turner Test. Day 9 at 210; Pl. Ex. 251 at EPA_RPT035296-301).

375. Several years before, in a January 2004 report prepared by a contractor for the Hartford Working Group likewise concluded that the well established pattern of rising groundwater and surface water elevations and increased house fires and hydrocarbon odor complaints/observations indicated that fluctuation of groundwater and surface water elevations was one of the primary factors controlling hydrocarbon vapor emanation from the subsurface beneath Hartford. (Pl. Ex. 191 at EPA_RPT022204).

376. To try to mitigate the risk of similar vapor intrusion problems at the home, the Hartford Working Group ultimately re-located an existing soil vapor extraction well on West Date Street so that it was closer to the home. (Cahnovsky Test. Day 3 at 97; Turner Test. Day 9 at 203).

E. Case Study 5: A Home on North Delmar Avenue in the North Central Part of North Hartford

377. The owner of the home at 119 West Date Street also owns the home at 504 North Delmar Avenue. She currently rents the home to a barge company that uses it to house some of its employees who work in the area. In the summer of 2007, two married couples were living in the home. One of the women who lived in the home was pregnant at the time. (Cahnovsky Test. Day 3 at 141-42; Turner Test. Day 9 at 210-11). After the problems at 119 West Date Street, the owner asked that the home at 504 North Delmar Avenue be added to the In-Home Interim Measures program. (Turner Test. Day 9 at 210-11).

378. Before the incident that occurred in 2007, there was no documented history of prior odor complaints at this home on North Delmar Avenue, although there had been at least one fire and numerous odor complaints at other locations within a block of the home (in 1978, 1979, 1990, 1993, 2004, and 2005). (Pl. Demo. Ex. 621; Pl. Ex. 191 at EPA_RPT022282-289, 291; Def. Ex. 586 at 43-49).

379. By May 2007, several soil vapor extraction wells were already operating beneath North Delmar Avenue near the home, and two more nearby wells were installed in August and October 2007 as part of the Phase 3 expansion of the Vapor Control System. (Pl. Demo. Ex. 507; Def. Ex. 1078 at 1-2, 6 (Figure 1)).

380. In late July 2007, a contractor for the Hartford Working Group performed an initial round of air sampling at the home, as part of its needs assessment under the In-Home Interim Measures program. (Turner Test. Day 9 at

210-12; Pl. Ex. 255 at EPA_RPT035724, 790; Pl. Ex. 259 at EPA_RPT035808). That initial sampling showed very high sub-slab levels of hydrocarbon vapors beneath the home, including isopentane at 640,000 $\mu g/m^3$, hexane at 100,000 $\mu g/m^3$, and benzene at 18,000 $\mu g/m^3$. Explosivity testing on that same day showed that the high total hydrocarbon levels beneath the basement foundation registered at 11% of the lower explosive limit. (Turner Test. Day 9 at 211; Def. Ex. 1116 at 48). Those levels were well above the risk-based comparison values established by the federal and state agencies under the Effectiveness Monitoring Plan. (Watters Test. Day 4 at 69-73; Pl. Ex. 250 at EPA_RPT035093).

381. In light of the hydrocarbon vapor levels, the residents of 504 North Delmar agreed to be relocated. (Turner Test. Day 9 at 212; Cahnovsky Test. Day 3 at 141-142).

382. Unlike the home on West Date Street that had severe vapor intrusion problems in May 2007, the hydrocarbon levels beneath the home on North Delmar Avenue did not subside quickly. Sub-slab sampling at the home showed elevated levels of isopentane, hexane and benzene for months. (Turner Test. Day 9 at 212; Pl. Ex. 255 at EPA_RPT035791; Def. Ex. 1078 at 1, 9 (Figure 4A)). As a result, the residents were not cleared to return to their home until December 2007. (Cahnovsky Test. Day 3 at 142-43; Watters Test. Day 4 at 69-73; Turner Test. Day 9 at 212).

383. The indoor and sub-slab vapor sampling that was done on July 30, 2007 was the first sampling at the home on North Delmar Avenue, so the vapor levels before then are not known. (Turner Test. Day 9 at 210-12).

XXX. Groundwater

384. The hydrocarbon plume's impact on groundwater in the area has been substantial. (Howe Test. Day 6 at 84). The groundwater in the area of free-phase and residual-phase LNAPL contamination beneath the northern part of the Village of Hartford is profoundly contaminated with hydrocarbon compounds such as benzene, ethylbenzene, toluene, and xylenes. (Turner Test. Day 10 at 35-37, 40-41; Pl. Ex. 207 at EPA_RPT 039300; Pl. Demo. Ex. 506; Pl. Ex. 201 at EPA_RPT041464-539; Pl. Ex. 254 at EPA_RPT035609).

385. In many locations beneath the Village, the contaminant levels are several orders of magnitude above pertinent regulatory thresholds such as Maximum Contaminant Levels ("MCLs") established under the U.S. EPA's National Primary Drinking Water Standards. MCLs are risk-based benchmarks that regulatory agencies use as preliminary remediation goals for groundwater. (Howe Test. Day 5 at 217; Howe Test. Day 6 at 84; Pl. Ex. 247 at ATSDR000856-57).

386. The scope of groundwater contamination has been confirmed by an extensive *Dissolved Phase Groundwater Investigation Report* that the Hartford Working Group prepared and submitted under the Administrative Order on Consent, and by the results of periodic groundwater sampling presented in Quarterly Groundwater Monitoring Reports submitted under that agreement. (Turner Test. Day 10 at 32-37; Pl. Ex. 200, 201, 202; Pl. Ex. 207, 208, 219, 220, 254).

387. The State of Illinois classifies the groundwater beneath Hartford as

"Class 1: Potable Resource Groundwater," which means that the groundwater is classified for current or future use as drinking water. (Cahnovsky Test. Day 3 at 70-71). Illinois has a separate classification for "Class 2: General Use Groundwater," which applies to groundwater that has been designated for industrial, agricultural, or other uses. (Cahnovsky Test. Day 3 at 71-72).

388. Illinois EPA's standards regarding the level of contaminants allowed in Class 1 and Class 2 groundwater are set forth at 35 Illinois Administrative Code, Part 620. (Cahnovsky Test. Day 3 at 72).

389. Under both U.S. EPA's MCLs and Illinois EPA's Class 1 groundwater standards, the drinking water standard for benzene in groundwater is 5 micrograms per liter ("μg/L"). (Faryan Test. Day 1 at 194; Pl. Ex. 247 at ATSDR000856-57; 40 C.F.R. § 141.61; Ill. Admin. Code tit. 35, § 620.410).

390. Groundwater samples collected beneath the Village of Hartford have exhibited benzene concentrations as high as 40,300 μg/L, a level that is 8,060 times the MCL. (Pl. Ex. 254 at EPA_RPT035609). As shown below, groundwater samples collected at monitoring wells throughout North Hartford have contained benzene concentrations that are at least 38 times the MCL. (The following groundwater sample information is presented from north to south throughout the Village, with all data taken from Pl. Ex. 254 at EPA_RPT035609).

- Well HMW-49D is located on North Delmar Avenue north of Rand Avenue. Groundwater samples collected at HMW-49D have contained benzene concentrations as high as 620 μg/L.

- Well HMW-38B is located on the Hartford Community Center property

near the intersection of West Rand Avenue and North Old St. Louis Road. Groundwater samples collected at HMW-38B have contained benzene concentrations as high as 7,550 μg/L.

- Well HMW-46C is located on the Hartford Community Center property, south of West Rand Avenue, between North Old St. Louis Road and North Delmar Avenue. Groundwater samples collected at HMW-46C have contained benzene concentrations as high as 9,290 μg/L.

- Well HMW-47C is located on the Hartford Community Center property near the corner of Rand Avenue and North Delmar Avenue. Groundwater samples collected at HMW-47C have contained benzene concentrations as high as 8,420 μg/L.

- Well HMW-48D is located on North Olive Street between Eats Rand Avenue and East Birch Street. Groundwater samples collected at HMW-48D have contained benzene concentrations as high as 8,750 μg/L.

- Well MP-78D is located on West Arbor Street near North Old St. Louis Road. Groundwater samples collected at MP-78D contained benzene concentrations as high as 20,300 μg/L.

- Well HMW-45C is located on West Arbor Street near North Delmar Avenue. Groundwater samples collected at HMW-45C have contained benzene concentrations as high as 16,600 μg/L.

- Well MP-79D is located on West Birch Street in between North Old St. Louis Road and North Delmar Avenue. Groundwater samples collected at MP-79D contained benzene concentrations as high as 18,800 μg/L.

- Well MP-85D is located on North Olive Street at the intersection with East Birch Street. Groundwater samples collected at MP-85D have contained benzene concentrations as high as 10,100 μg/L.

- Well MP-83C is located on North Old St. Louis Road between West Birch Street and West Cherry Street. Groundwater samples collected at MP-83C have contained benzene concentrations as high as 9,310 μg/L.

- Well HB-31 is located just south of West Birch Street in between North Old St. Louis Road and North Delmar Avenue. Groundwater samples collected at HB-31 contained benzene concentrations as high as 25,400 μg/L.

- Well MP-30C is located near North Delmar Avenue between West Birch Street and West Cherry Street. Groundwater samples collected at MP-30C have contained benzene concentrations as high as 11,900 μg/L.

- Well HB-32 is located on North Market Street between East Birch Street and East Cherry Street. Groundwater samples collected at HB-32 have contained benzene concentrations as high as 1,330 μg/L.

- Well MP-31C is located on West Cherry Street near the intersection with Old St. Louis Road. Groundwater samples collected at MP-31C have contained benzene concentrations as high as 12,300 μg/L.

- Well MP-32C is located on West Cherry Street in between North Old St. Louis Road and North Delmar Avenue. Groundwater samples collected at MP-32C have contained benzene concentrations as high as 17,200 μg/L.

- Well MP-33D is located on West Cherry Street in between North Old St. Louis Road and North Delmar Avenue. Groundwater samples collected at MP-33D have contained benzene concentrations as high as 25,600 μg/L.

- Well MP-34C is located on West Cherry Street near the intersection with North Delmar Avenue. Groundwater samples collected at MP-34C have contained benzene concentrations as high as 34,000 μg/L.

- Well MP-36C is located across the railroad tracks from North Market Street, north of East Cherry Street. Groundwater samples collected at MP-36C have contained benzene concentrations as high as 29,700 μg/L.

- Well MP-38C is located near North Old St. Louis Road between West Cherry Street and West Date Street. Groundwater samples collected at MP-38C have contained benzene concentrations as high as 38,600 μg/L.

- Well MP-43C is located on West Date Street near North Old St. Louis Road. Groundwater samples collected at MP-43C have contained benzene concentrations as high as 31,200 μg/L.

- Well MP-40C is located on North Delmar Avenue just north of the intersection with Date Street. Groundwater samples collected at MP-40C have contained benzene concentrations as high as 16,000 μg/L.

- Well MP-41C is located on North Market Street just north of the

intersection with East Date Street. Groundwater samples collected at MP-41C have contained benzene concentrations as high as 25,900 $\mu g/L$.

- Well MP-44D located on East Date Street near the intersection of North Market Street. Groundwater samples collected at MP-44D have contained benzene concentrations as high as 25,900 $\mu g/L$.

- Well MP-48C is located in the alley between West Date Street and West Elm Street, and between Old St. Louis Road and North Delmar Avenue. Groundwater samples collected at MP-48C have contained benzene concentrations as high as 21,000 $\mu g/L$.

- Well MP-52C is located on North Market Street just north of the intersection with East Elm Street. Groundwater samples collected at MP-52C have contained benzene concentrations as high as 33,200 $\mu g/L$.

- Well HB-37 is located on East Elm Street between North Market Street and North Olive Street. Groundwater samples collected at HB-37 have contained benzene concentrations as high as 32,800 $\mu g/L$.

- Well MP-86C is located on North Delmar Avenue north of the intersection with Forest Street. Groundwater samples collected at MP-86C have contained benzene concentrations as high as 34,300 $\mu g/L$.

- Well RW1 is located north of East Forest Street near North Delmar Avenue. Groundwater samples collected at RW1 have contained benzene concentrations as high as 7,660 $\mu g/L$.

- Well HMW-44D is located on North Olive Street in between East Elm Street and East Forest Street. Groundwater samples collected at HMW-44D have contained benzene concentrations as high as 2,220 $\mu g/L$.

- Well HMW-41B is located on West Forest Street near North Delmar Avenue. Groundwater samples collected at HMW-41B have contained benzene concentrations as high as 5,060 $\mu g/L$.

- Well MP-59C is located near North Market Street, between East Watkins Street and East Forest Street. Groundwater samples collected at MP-59C have contained benzene concentrations as high as 40,300 $\mu g/L$.

- Well MP-58C is located in the alley between East Forest Street and East Watkins Street, and between North Market Street and North Olive Street. Groundwater samples collected at MP-58C have contained

benzene concentrations as high as 38,500 μg/L.

- Well HMW-54C is located on North Olive Street between East Forest Street and East Watkins Street. Groundwater samples collected at HMW-54C have contained benzene concentrations as high as 1,760 μg/L.

- Well HMW-42B is located on North Market Street south of the intersection with East Watkins Street. Groundwater samples collected at HMW-42B have contained benzene concentrations as high as 220 μg/L.

- Well MP-88C is located on East Watkins Street in between North Market Street and North Olive Street. Groundwater samples collected at MP-88C have contained benzene concentrations as high as 28,700 μg/L.

- Well MP-64C is located on East Watkins Street near the intersection with North Olive Street. Groundwater samples collected at MP-64C have contained benzene concentrations as high as 34,200 μg/L.

- Well HMW-53B is located on North Olive Street near the intersection with East Watkins Street. Groundwater samples collected at HMW-53B have contained benzene concentrations as high as 18,600 μg/L.

- Well HB-38 is located in the alley between East Watkins Street and East Maple Street, and between North Market Street and North Olive Street. Groundwater samples collected at HB-38 have contained benzene concentrations as high as 261 μg/L.

- Well MP-63C is located in the alley between East Watkins Street and East Maple Street, and between North Market Street and North Olive Street. Groundwater samples collected at MP-63C have contained benzene concentrations as high as 193 μg/L.

- Well HMW-43C is located on North Olive Street, south of the intersection with East Watkins Street. Groundwater samples collected at HMW-43C have contained benzene concentrations as high as 4,630 μg/L.

391. Groundwater “grab”samples collected during ROST investigations in 2004 and 2005 identified BETX (benzene, ethylbenzene, toluene, xylene)

contamination in groundwater (dissolved-phase hydrocarbons) at locations south and west of the known extent of free-phase and residual-phase hydrocarbons (Pl. Ex. 200 at EPA_RPT041418):

- HROST-89 is located just west of Illinois State Route 3, south of West Rand Avenue. Groundwater samples collected at HROST-89 have contained Total BETX levels as high as 140.1 μg/L.

- HROST-94 is located just west of Illinois State Route 3, south of West Arbor Street. Groundwater samples collected at HROST-94 have contained Total BETX levels as high as 3,221.2 μg/L.

- HROST-96 is located just west of Illinois State Route 3, north of West Cherry Street. Groundwater samples collected at HROST-96 have contained Total BETX levels as high as 170 μg/L.

- HROST-60 is located on North Delmar Avenue between Watkins Street and Maple Street. Groundwater samples collected at HROST-60 have contained Total BETX levels as high as 29.8 μg/L.

- HROST-112 is located on North Olive Street between East Maple Street and East Hawthorne Avenue. Groundwater samples collected at HROST-112 have contained Total BETX levels as high as 20.7 μg/L.

- HROST-119 is located on South Olive Street at East Second Street. Groundwater samples collected at HROST-119 have contained Total BETX levels as high as 1,301 μg/L.

- HROST-120 is located on South Olive Street at East Third Street. Groundwater samples collected at HROST-120 have contained Total BETX levels as high as 11.7 μg/L.

- HROST-121 is located on South Olive Street at East Fourth Street. Groundwater samples collected at HROST-121 have contained Total BETX levels as high as 160 μg/L.

392. The groundwater contamination at Hartford contains some of the highest concentrations of contaminants that EPA On-Scene Coordinator Steve Faryan has encountered in his 21 year career as an On-Scene Coordinator, especially over

a large geographic area. (Faryan Test. Day 1 at 95-96, 201).

393. Beyond being an ongoing source of contamination of groundwater beneath North Hartford, the hydrocarbon contamination in the area may pose other threats to human health and the environment. First, the contamination may endanger groundwater just to the south of the main area of LNAPL contamination, which is used as drinking water in the Village of Hartford. Second, contaminated groundwater may migrate and risk contaminating the Mississippi River. Third, even if the contamination beneath the Village is remediated, contaminated groundwater beneath the Hartford Refinery property may migrate to the west and recontaminate the area beneath the Village. (Turner Test. Day 10 at 33-41).

394. The existing groundwater contamination beneath North Hartford is present in the Main Sand Aquifer, the same aquifer from which the Village draws its drinking water supply. (Faryan Test. Day 1 at 172). The groundwater contamination extends south of Watkins Street in some areas, just to the north of the groundwater recharge area for Hartford's municipal drinking water wells. (Turner Test. Day 10 at 33-35, 40-41; Pl. Demo. Ex. 506). For example, benzene-contaminated groundwater has been found at monitoring point HROST-60, which is located on North Delmar Avenue between Watkins Street and Maple Street (Pl. Ex. 200 at EPA_RPT041418) and at well HB-38, located in the alley between East Watkins Street and East Maple Street, east of North Market Street (Pl. Ex. 254 at EPA_RPT035609). The contaminated groundwater at that monitoring point is only about two city blocks (or about 500 feet) from the groundwater recharge zone for

Hartford's drinking water wells. (Faryan Test. Day 1 at 205-06; Pl. Ex. 200 at EPA_RPT041412, 41418; Pl. Ex. 254 at EPA_RPT035609).

395. Five Sentinel Wells have been installed in the area between the known groundwater contamination and the recharge area for Hartford's municipal wells. Those Sentinel Wells have not shown evidence of hydrocarbon contamination since they were first sampled in December 2003. (Turner Test. Day 10 at 33-35; Pl. Demo. Ex. 506; Pl. Ex. 259 at EPA_RPT035799, 35803; Pl. Ex. 200 at EPA_RPT041354).

396. Under natural flow conditions, the groundwater beneath North Hartford would normally flow to the west and to the southwest, toward the Mississippi River (and toward the recharge zone for Hartford's municipal wells). (Howe Test. Day 6 at 44; Sharma Test. Day 14 at 99-100, 116; Pl. Ex. 168 at EXPRT000187; Pl. Ex. 200 at EPA_RPT041360-361; Pl. Ex. 203 at EPA_RPT038416). The recharge zone or well-head protection area is the area from which the municipal wells draw drinking water, the area within the municipal wells' cone of influence. (Faryan Test. Day 1 at 193). If contamination reaches the recharge zone, there is a high likelihood that it will impact the drinking water drawn from the wells. (Faryan Test. Day 1 at 203).

397. The natural groundwater flow has been altered by industrial groundwater pumping at several industrial facilities in the area, including at the Hartford Refinery property just east of the Village, at the Shell Oil Refinery east and northeast of the Village, and at the former Amoco Refinery northeast of the Village. As a result, groundwater in the Main Sand Aquifer generally flows in a northerly direction. (Howe Test. Day 6 at 44; Sharma Test. Day 14 at 98-99, 116; Pl. Ex. 168

at EXPRT000187; Pl. Ex. 200 at EPA_RPT041360-361, 385, 400; Pl. Ex. 203 at EPA_RPT038416-417).

398. The Shell Oil Refinery and the former Amoco Refinery facility are subject to Resource Conservation and Recovery Act permits that require continued groundwater pumping to maintain hydraulic control of the groundwater at those facilities. (Sharma Test. Day 14 at 98-99; Sharma Test. Day 15 at 24-25; Def. Ex. 791 at 11). There currently is no corresponding requirement applicable to the Hartford Refinery property. (Turner Test. Day 10 at 37-38; Sharma Test. Day 15 at 24-25).

399. At times, the groundwater beneath the Village flows to the northwest, toward the Mississippi River. (Pl. Ex. 200 at EPA_RPT041385, 41406, 41427; Pl. Ex. 208 at EPA_RPT041124; Def. Ex. 995 at 92, 98-101 (Figures 2-12, 2-18, 2-19, 2-20, 2-21); Sharma Test. Day 15 at 13-15). The plume of dissolved-phase hydrocarbon contamination therefore extends north and west of the free-phase and residual-phase LNAPL contamination beneath the Village. (Pl. Ex. 200 at EPA_RPT041354). Elevated levels of benzene and total BTEX compounds (benzene, toluene, ethylbenzene, and xylenes) have been detected in groundwater north of Rand Avenue and west of Illinois State Route 3. (Pl. Ex. 200 at EPA_RPT041418, 41419). The intersection of Rand Avenue and Illinois State Route 3 is approximately 2,000 feet east of the Mississippi River. (Pl. Ex. 194 at EPA_RPT036000-01).

XXXI. The Active LNAPL Recovery System Remedy

400. When U.S. EPA assumed primary responsibility for the Hartford Site in 2003, there were several pre-existing standalone wells that had been installed and equipped with skimmer pumps for recovery of liquid hydrocarbons. Only one or two of those wells were operating in 2003. The wells had limited geographic influence and their design limited their efficacy as groundwater levels rose and fell beneath North Hartford. Thus, U.S. EPA saw severe limitations on what could be accomplished with those recovery wells. (Turner Test. Day 9 at 169-172).

401. As required by the Administrative Order on Consent with U.S. EPA, the Hartford Working Group performed extensive work to identify additional approaches and technologies that could be used for a full-scale system to recover the free-phase and residual-phase hydrocarbon contamination beneath the Village. (Turner Test. Day 10 at 5; Pl. Ex. 199; Pl. Ex. 203 at EPA_RPT038418-438; Pl. Ex. 204).

402. Those efforts included work to characterize the nature and extent of contamination at the Hartford Site, LNAPL sampling and analysis studies, LNAPL recharge evaluations to assess hydrocarbon recovery potential in different areas at the Site, soil core sampling, and pilot tests and modeling on multiple recovery technologies, including multi-phase extraction. (Turner Test. Day 10 at 5-9, 10-13; Pl. Ex. 203 at EPA_RPT038418-475).

403. Using all of the information gathered in those studies, the Hartford Working Group identified and evaluated eight different LNAPL recovery technologies and summarized the results of that assessment in a formal report that was required

to be submitted to U.S. EPA under the Administrative Order on Consent. (Turner Test. Day 10 at 13; Pl. Ex. 203 at EPA_RPT038439-475). That February 2006 report – entitled *Proposal for an Active LNAPL Recovery System* (or the "Remedy Proposal Report") – performed that technology evaluation separately for several different areas and sub-areas at the Site, as depicted on a map included in the report. (Turner Test. Day 10 at 15-16; Pl. Ex. 203 at EPA_RPT038439-475, 38544). In each of those areas, the different recovery technologies were evaluated based on standard remedy selection criteria set forth in the National Contingency Plan, such as protectiveness, cost, long-term effectiveness, and implement ability. (Turner Test. Day 10 at 13-15; Pl. Ex. 145 at APEXDEPO_005299; Pl. Ex. 203 at EPA_RPT038439-475; 40 C.F.R. 300.430(e)(9)).

404. The Remedy Proposal Report selected multi-phase extraction as the primary LNAPL recovery technology for Area A, along North Olive Street, between East Forest Street and East Elm Street. Area A surrounds well HMW-44C, and hydrocarbon recovery pilot testing at that well in 2005 showed that it had by far the greatest hydrocarbon yield and recharge potential of any of the wells that were tested at the Site. (Turner Test. Day 10 at 16-17; Pl. Ex. 203 at EPA_RPT038403, 38405, 38451-453, 38466-467, 38544; Pl. Ex. 204 at EPA_RPT010707–0021-0023).

405. Multi-phase extraction uses a network of wells, a vacuum system, and piping to collect both liquid, free-phase and vapor-phase hydrocarbon contamination from subsurface soils. The piping leads to associated facilities where the recovered liquids and vapors are separated, collected, and treated or destroyed. Multi-phase

extraction can remove liquid phase LNAPL from wetter subsurface areas, at and near the surface of the groundwater, and it also can volatilize and remove residual-phase LNAPL from drier soils using vapor extraction. (Turner Test. Day 10 at 9-10; Pl. Ex. 203 at EPA_RPT038441-442, 545).

406. The Remedy Proposal Report also selected multi-phase extraction as the primary LNAPL recovery technology in the sub-areas of Area B (designated as Areas B-1, B-2, B-3, and B4). Those areas showed moderate to strong potential for LNAPL recovery using multi-phase extraction. (Turner Test. Day 10 at 17; Pl. Ex. 203 at EPA_RPT038405-407, 38457-459, 38468-469, 38544).

407. Due to the comparatively low potential for liquid phase LNAPL recovery in other areas at the Site, the Remedy Proposal Report selected soil vapor extraction as the primary recovery technology in those remaining areas, which were designated as Area C. (Turner Test. Day 10 at 17; Pl. Ex. 203 at EPA_RPT038405, 463-465, 469-470, 544).

408. Soil vapor extraction uses a network of wells, a vacuum system, and piping to volatilize and remove LNAPL from drier subsurface soils. Unlike many of the soil vapor extraction wells in the pre-existing Vapor Control System, the additional wells for the Active LNAPL Recovery System would be designed to maximize removal of LNAPL mass (rather than to collect vapors in shallower soils for vapor intrusion mitigation). (Turner Test. Day 9 at 185-186, 194; Pl. Ex. 203 at EPA_RPT038443, 469, 543).

409. In May 2006, U.S. EPA approved the Proposal for an Active LNAPL

Recovery System with only limited modifications, which were detailed in U.S. EPA's approval letter. (Turner Test. Day 10 at 17-18; Pl. Ex. 359).

410. As required by the Administrative Order on Consent, the Hartford Working Group began work on the design of the Active LNAPL Recovery System after U.S. EPA approved that remedy. (Turner Test. Day 10 at 18-19).

411. That design process took the remedy to a much greater level of specificity, establishing things such as: (I) multi-phase extraction and soil vapor extraction well location and spacing; (ii) well size and well construction; (iii) collection system piping location and materials; (iv) detailed plans for treatment and disposal of hydrocarbon liquids, hydrocarbon vapors, and groundwater from the collection systems; and (v) remedy coverage areas. (Turner Test. Day 10 at 18-19; Pl. Ex. 206).

412. The results of that detailed design work were presented in another major submittal that was required under the Administrative Order on Consent, called the *Active LNAPL Recovery System 90% Design Report* (or the "90% Design Report"). (Turner Test. Day 9 at 179-180; Day 10 at 19; Pl. Ex. 206).

413. Among other things, the 90% Design Report revised the boundaries of the different recovery areas (i.e., Areas A, B1, B2, B3, B4, and C), as set forth in a map that was included in the report. (Turner Test. Day 10 at 19-20; Pl. Ex. 206 at EPA_RPT039924-25, 961). The Report also indicated that recovery efforts with certain technologies would focus on particular geologic strata in some areas. For example, in different portions of sub-area B4 in the northernmost part of North Hartford, the Report proposed use of multi-phase extraction to target LNAPL

contamination in different strata at different depths (i.e., in the Rand stratum, the EPA stratum, or in the Main Sand). (Turner Test. Day 10 at 20-21; Pl. Ex. 206 at EPA_RPT039921-923, 961).

414. The 90% Design Report also proposed a specific layout for new multi-phase extraction wells and soil vapor extraction wells, based on the projected radii of influence for those well types and a degree of planned overlap, as determined from earlier pilot testing. (Turner Test. Day 10 at 21-25; Pl. Ex. 206 at EPA_RPT03, 39968-969). The Report recognized that the final well spacing and layout will need to depend upon the wells' actual performance and effective radius of influence during the remedy phase-in. (Turner Test. Day 10 at 29; Pl. Ex. 206 at EPA_RPT039934-937).

415. The 90% Design Report also presented a design and plans for fluid separation, wastewater treatment, and disposal, including detailed plans and drawings for a new wastewater treatment plant and associated piping to handle the contaminated water collected by the multi-phase extraction system. (Turner Test. Day 10 at 25-26; Pl. Ex. 206 at EPA_RPT039947-951, 40492-540).

416. The 90% Design Report included detailed design drawings and specifications for other key elements of the Active LNAPL Recovery System, including the multi-phase extraction system and soil vapor extraction system piping and layout, the construction of the multi-phase extraction and soil vapor extraction wells, belowground vapor/liquid separators, construction and layout of piping vaults and trenches, vacuum blowers, instrumentation systems, and thermal oxidizers. (Pl. Ex.

206 at EPA_RPT040460-491, 40541-41023).

417. U.S. EPA had significant technical exchanges with the Hartford Working Group regarding the 90% Design Report, particularly on two major issues identified by U.S. EPA. (Turner Test. Day 10 at 26-30).

418. First, U.S. EPA identified a need to fill certain gaps in the recovery system's coverage, as proposed by the 90% Design Report. For example, U.S. EPA determined that additional multi-phase extraction wells would be needed in Area B2 (between West Elm Street and West Date Street, to the west of North Market Street). U.S. EPA also identified the need for installation of additional wells in Area B4, especially along Rand Avenue and the northernmost parts of North Delmar Avenue. (Turner Test. Day 10 at 27-28; Pl. Ex. 206 at EPA_RPT039961, 968-69).

419. Second, U.S. EPA determined that it would be beneficial and feasible to phase-in the remedy over two to three years, as compared to the four to five year phase-in period proposed by the Hartford Working Group. (Turner Test. Day 10 at 29-30; Pl. Ex. 206 at EPA_RPT039932-937).

420. In December 2007, U.S. EPA sent the Hartford Working Group a letter to memorialize acceptance of the 90% Design Report, with caveats that the final design for the Active LNAPL Recovery System would need to be adjusted to address U.S. EPA's comments and concerns regarding coverage in certain areas and the timing for the remedy phase-in. Very little additional work will be required to finalize the design. (Turner Test. Day 10 at 26-27, 30-31).

421. Construction work on the Active LNAPL Recovery System could have

begun in the spring of 2008 and, therefore, can begin promptly. (Turner Test. Day 10 at 30-31).

422. Once the Active LNAPL Recovery System is fully-installed, it will probably need to operate for 15-25 years. (Turner Test. Day 10 at 31).

423. Some aspects of the System, such as the wastewater treatment plant and the thermal treatment unit, will need to be operated and monitored on a constant basis throughout that period of operation. Other parts of the system will need to be adjusted periodically. Many elements of the system will need to be maintained (and some will need to be repaired and/or replaced) during operation of the Active LNAPL Recovery System. (Turner Test. Day 10 at 31-32).

424. One of the Defendant's expert witnesses opined that the Active LNAPL Recovery System "will not only remove residual and mobile LNAPL within the Main Sand unit, but will over time eliminate and/or minimize vapors concentrations [sic] originating from the Main Sand unit." (Def. Ex. 791 at 13).

425. Although the Hartford Working Group has expressed some willingness to begin installing an initial phase of the Active LNAPL Recovery System in 2008 (consisting of a few multi-phase extraction wells in Area A), the Hartford Working Group is not required to do that work or any other remedy implementation work under the existing Administrative Order on Consent with U.S. EPA. (Turner Test. Day 9 at 181-182; Turner Test. Day 10 at 30-31; Pl. Ex. 145).

426. The Active LNAPL Recovery System targets removal of free-phase and residual-phase hydrocarbons beneath the Village of Hartford. It will not remediate

contaminated groundwater beneath the Village (although it will help remove the main source of that dissolved-phase contamination, so that large scale groundwater remediation can begin). (Turner Test. Day 10 at 41-45; Pl. Ex. 203; Pl. Ex. 206).

427. The Active LNAPL Recovery System also will not remediate hydrocarbon contamination that exists beneath the Hartford Refinery property. (Turner Test. Day 10 at 39-40; Pl. Ex. 183; Pl. Ex. 203; Pl. Ex. 206).

XXXII. Groundwater Remedy

428. Once the LNAPL beneath the Village is removed as a source of continuing groundwater contamination, a separate groundwater treatment system will be required to remediate the groundwater itself. That will likely require installation of a relatively large-scale groundwater pump-and-treat system that would withdraw and treat large volumes of contaminated groundwater. That system would need to have a much larger water treatment capacity than the comparatively small water treatment plant that will be built to treat smaller volumes of contaminated water generated by the multi-phase extraction portion of the Active LNAPL Recovery System. (Turner Test. Day 10 at 41-45).

429. Even with the current groundwater pumping at the former Hartford Refinery, groundwater in certain stratigraphic layers flows from the Refinery property toward the Village. (Pl. Ex. 200 at EPA_RPT041408, 41426). Groundwater in the EPA stratum flows southwest from the Refinery toward the Village, until it comes into contact with the Main Sand and then flows in a north/northwesterly direction. (Pl. Ex.

200 at EPA_RPT041360-361, 406, 408-409; Pl. Ex. 208 at EPA_RPT041111-112; Pl. Ex. 182 at HOWE000021-22, 056).

430. The EPA stratum and Main Sand stratum beneath the Refinery property are highly contaminated with petroleum constituents, including along the western boundary of the property near the Village. (Pl. Ex. 182 at HOWE000043, 084, 089, 091). Groundwater along the western edge of the Refinery property also is contaminated with benzene and other BTEX compounds. (Pl. Ex. 182 at HOWE000084). For example, sampling at monitoring well RMW-41 – which is located near the northwest edge of the Refinery property – found both free-phase hydrocarbon contamination and dissolved-phase groundwater contamination (including benzene in the Main Sand Aquifer at levels above 5,000 µg/L, well in excess of the 5 µg/L standard set by U.S. EPA's MCLs and Illinois EPA's Class I Groundwater Quality Standards). (Pl. Ex. 182 at HOWE000084; Pl. Ex. 184 at HOWE000935-939, 1036).

431. Under a voluntary arrangement with Illinois EPA, Premcor/Valero has taken some steps to study and control the westward migration of contamination from the Hartford Refinery toward the Village, but that currently is not being done under any enforceable agreement. (Turner Test. Day 10 at 37-38; Pl. Ex. 183).

CONCLUSIONS OF LAW

A. Statutory Overview

432. In enacting the **Resource Conservation and Recovery Act ("RCRA")**, Congress declared a national policy of "minimiz[ing] the present and future threat to

human health and the environment" posed by solid and hazardous wastes. See RCRA Section 1003(b), 42 U.S.C. § 6902(b). "RCRA is a remedial statute, which should be liberally construed." **United States v. Aceto Agric. Chems. Corp., 872 F.2d 1373, 1383 (8th Cir. 1989)**.

433. The "endangerment" provision in RCRA Section 7003(a) is one of the statute's most important enforcement tools, and it is intended to "give broad authority to the courts to grant all relief necessary to ensure complete protection of the public health and the environment." **Id. (quoting United States v. Conservation Chem. Co., 619 F. Supp. 162, 199 (W.D. Mo. 1985) (C.J. Wright)); see also United States v. Waste Indus., Inc., 734 F.2d 159, 167 (4th Cir. 1984) ("Section 7003 is a congressional mandate that the former common law of nuisance, as applied to situations in which a risk of harm from solid or hazardous waste exists, shall include new terms and concepts which shall be developed in a liberal, not a restrictive, manner."); United States v. Price, 688 F.2d 204, 211 (3d Cir. 1982) ("By enacting the endangerment provisions of RCRA . . . Congress sought to invoke the broad and flexible equity powers of the federal courts . . . .")**.

434. **RCRA Section 7003(a)** provides in pertinent part:

> [U]pon receipt of evidence that the past or present handling, storage, treatment, transportation, or disposal of any solid waste or hazardous waste may present an imminent and substantial endangerment to health or the environment, the Administrator may bring suit on behalf of the United States . . . against any person . . . who has contributed or who is contributing to such handling, storage, treatment, transportation or disposal to restrain such person . . ., to order such person to take such other

action as may be necessary, or both.

42 U.S.C. § 6973(a).

435. **RCRA Section 7003(a)** imposes strict liability without regard to fault or negligence. **See United States v. Northeastern Pharm. & Chem. Co., Inc., 810 F.2d 726, 738, 740 (8th Cir. 1986); Aceto, 872 F.2d at 1377; S. Rep. No. 98-284, at 58 (1983).**

436. To establish liability under **RCRA Section 7003(a)**, the United States must show:

> (1) conditions which present or may present an imminent and substantial endangerment;
>
> (2) the endangerment stems from the handling, storage, treatment, transportation, or disposal of solid or hazardous waste; and
>
> (3) defendant[] [has] contributed to or [is] contributing to such handling, storage, treatment, transportation, or disposal."

Aceto, 872 F.2d at 1382 n.9.

B. Conditions at the Hartford Site Present or May Present an Imminent and Substantial Endangerment to Health and the Environment.

437. In construing whether conditions "may present an imminent or substantial endangerment" under **RCRA Section 7003(a)**, the operative word is "*may*." **See, e.g., Interfaith Cmty. Org. v. Honeywell Int'l, Inc., 399 F.3d 248, 258 (3d Cir. 2005); Parker v. Scrap Metal Processors, Inc., 386 F.3d 993, 1014-15 (11th Cir. 2004); Dague v. City of Burlington, 935 F.2d 1343, 1355 (2d Cir. 1991); United States v. Valentine, 856 F. Supp. 621, 626 (D. Wyo. 1994) (C.J.**

Johnson).[4] Thus, the United States "must only show that there is a ***potential*** for an imminent threat of serious harm." Interfaith Cmty., 399 F.3d at 258 (emphasis added, internal quotations omitted).

438. Courts have long rejected the proposition that RCRA Section 7003 is limited to "emergency situations." See United States v. Waste Indus., Inc., 734 F.2d 159, 165 (4th Cir. 1984); Maine People's Alliance & Natural Res. Def. Counsel v. Mallinckrodt, Inc., 471 F.3d 277, 287-88 (1st Cir. 2006). As the First Circuit recognized in Maine People's Alliance:

> Imminence generally has been read to require only that the harm is of a kind that poses a near-term threat; there is no corollary requirement that the harm necessarily will occur or that the actual damage will manifest itself immediately.

Maine People's Alliance, 471 F.3d at 288. In using the phrase "near-term threat," the First Circuit emphasized:

> It is the ***threat*** that must be close at hand, even if the perceived ***harm*** is not. For example, if there is a reasonable prospect that a carcinogen released into the environment today may cause cancer twenty years hence, the threat is near-term even though the perceived harm will only occur in the distant future.

Id. at 279 n.1 (emphasis in original). See also S. Rep. No. 98-284, at 58-59

[4] Cases such as Interfaith Community, Parker, and Dague that have interpreted RCRA's corresponding citizen suit provision – **RCRA Section 7002(a)(1)(B), 42 U.S.C. § 6972(a)(1)(B)** – are instructive on this point because the citizen suit provision includes the same endangerment standard. In Cox v. City of Dallas, the Fifth Circuit – reviewing legislative history and applying the "normal rule of statutory construction that identical words used in different parts of the same act are intended to have the same meaning" – recognized that the elements of liability under RCRA Sections 7002 and 7003 are to be similarly interpreted. **Cox v. City of Dallas, 256 F.3d 281, 294 n.22 (5th Cir. 2001) (quoting Commissioner v. Lundy, 516 U.S. 235, 250 (1996))**.

(1983).

439. The "substantial" element of the endangerment analysis is similarly broad. "An endangerment is substantial if there is some reasonable cause for concern that someone or something may be exposed to a risk of harm . . . if remedial action is not taken." **United States v. Union Corp., 259 F. Supp. 2d 356, 400 (E.D. Pa. 2003) (C.J. Giles). See also Valentine, 856 F. Supp. at 626 (endangerment is substantial if "there exists reasonable cause for concern for the integrity of the public health or the environment.")**.

440. The Third Circuit, in Interfaith Community, explicitly rejected an argument that a quantifiable threshold of harm needs to be met before an endangerment is "substantial," finding no support for such an interpretation in the legislative history, interpretive case law, or dictionary definition of the term. **399 F.3d at 259-60. See also Union Corp., 259 F. Supp. 2d at 400 ("The requirement that an endangerment be substantial does not require quantification of the endangerment (e.g., proof that a certain number of persons will be exposed, that 'excess deaths' will occur, or that a water supply will be contaminated to a specific degree)." (citation omitted))**.

441. **RCRA Section 7003's** "unequivocal statutory language and . . . legislative history make it clear that Congress . . . intended to confer upon the courts the authority to grant affirmative equitable relief to the extent necessary to eliminate ***any risks*** posed by toxic wastes." **Price, 688 F.2d at 213-14** (emphasis added).

Congress cited that language in Price with approval when it added **RCRA Section 7002's** parallel citizen suit provision. **See S. Rep. No. 98-284 at 59 (1983) (quoting Price, 688 F.2d at 213-14)**.

442. The pertinent legislative history also confirms that the government's burden of proving endangerment is low – certainty and exactitude are not required:

> The primary intent of [Section 7003] is to protect human health and the environment; hence, the courts should consider both the nature of the endangerment which may be presented and its likelihood, recognizing that risk may be assessed from suspected, but not completely substantiated, relationships between facts, from trends among facts, from theoretical projections, from imperfect data, or from probative preliminary data not yet certifiable as 'fact.'

S. Rep. No. 98-284, at 59 (1983) (internal quotations omitted). **See also Interfaith Cmty., 399 F.3d at 259 ("[I]f an error is to be made in applying the endangerment standard, the error must be made in favor of protecting public health, welfare, and the environment.") (quoting Conservation Chem., 619 F. Supp. at 194)**.

443. Vapors emanating from hydrocarbon contamination in soils at the Hartford Site present or may present an imminent and substantial endangerment to health, because Hartford residents who are exposed chemicals contained in those vapors may suffer adverse health effects.

444. Vapors emanating from hydrocarbon contamination in soils at the Hartford Site present or may present an imminent and substantial endangerment to health, because Hartford residents may be harmed by fires or explosions caused by

those vapors.

445. Hydrocarbon contamination at the Hartford Site presents or may present an imminent and substantial endangerment to the environment, because hydrocarbon constituents are contaminating the groundwater.

446. By its terms, **RCRA Section 7003** expressly addresses spilled or leaked waste materials that "may enter the environment or be emitted into the air or discharged into any waters, ***including ground waters***." **42 U.S.C. § 6903(3)** (definition of the term "disposal" – emphasis added). The State of Illinois has formally acknowledged groundwater as a "natural and public resource" and recognized "the essential and pervasive role of groundwater in the social and economic well-being of the people of Illinois, and its vital importance to the general health, safety, and welfare." **415 Ill. Comp. Stat. 55/2(b)**.

447. Illinois has a general prohibition against the impairment of groundwater, which provides: "No person shall cause, threaten or allow the release of any contaminant to a resource groundwater such that: 1) Treatment or additional treatment is necessary to continue an existing use or to assure a potential use of such groundwater; or 2) An existing or potential use of such groundwater is precluded." **Ill. Admin. Code tit. 35, § 620.301 (2007)**.

448. Several leading cases have held that actual groundwater contamination essentially constitutes a *per se* endangerment to the environment under RCRA. **<u>See, e.g.</u>, <u>Interfaith Cmty.</u>, 399 F.3d at 261-63 (proof of groundwater contamination**

in excess of governmental standards "may alone suffice for liability" because RCRA's endangerment provisions "impose[] liability for endangerments to the environment, including water in and of itself"); United States v. Hill, No. 95-CV-1716, 1998 WL 278291, at *4 (N.D.N.Y. May 20, 1998) (J. Pooler) (finding that a plume of hydrocarbons from leaking underground pipes posed an actual endangerment based on "analyses of groundwater samples . . . reveal[ing] levels of benzene and toluene which exceeded acceptable levels under federal safe drinking water standards").

449. In this Circuit, an endangerment to the environment is established if contamination ***could*** leach into groundwater, even if the groundwater does not flow into any source of drinking water. **See PMC, Inc. v. Sherwin-Williams Co., 151 F.3d 610, 618 (7th Cir. 1998) ("the toxic wastes are buried; but the buried wastes contain lead that is a constant danger to the groundwater, so that some cleaning up is necessary in the interest of health, which is what the statute requires"), affirming PMC, Inc. v. Sherwin-Williams Co., No. 93 C 1379, 1997 WL 223060, at *1 (N.D. Ill. Apr. 29, 1997) ("The groundwater at the PMC Facility does not flow into any source of drinking water."). Accord Hill, 1998 WL 278291 at *1 (summary judgment granted despite factual dispute regarding whether contaminated aquifer was source of drinking water); United States v. Ottati & Goss, Inc., 630 F. Supp. 1361, 1373, 1384-85, 1394 (D.N.H. 1985) (J. Laughlin) (imminent and substantial endangerment found despite "no**

evidence that any resident . . . has or is in danger of having their drinking water contaminated . . . .”).

450. In this case, it is not only true that the accumulated waste ***could*** contaminate the groundwater; it already ***has*** done so and it is a ***continuing*** source of further contamination.

451. Here, hydrocarbon contamination at the Hartford Site also presents or may present an imminent and substantial endangerment to health, because groundwater that is contaminated with hydrocarbon constituents (such as benzene) is very close to the recharge area for the Village of Hartford’s public drinking water supply wells, and that contaminated groundwater could migrate toward or otherwise affect that recharge area

452. Hydrocarbon contamination at the Hartford Site presents or may present an imminent and substantial endangerment to the environment, because contaminated groundwater at the Site is very close to the Mississippi River and it could migrate westward and contaminate the River.

453. Finally, hydrocarbon contamination beneath the Hartford Refinery presents or may present an imminent and substantial endangerment to health and the environment, because contaminated groundwater beneath the Refinery may migrate westward beneath the Village.

C. The Endangerment at the Hartford Site Stems from the Handling, Storage, Treatment, Transportation, and/or Disposal of Solid Waste.

454. The endangerment at the Hartford Site stems from the handling, storage,

treatment, transportation, and/or disposal of solid waste. More specifically, the endangerment at the Site stems from hydrocarbon contamination in soils and groundwater caused by the handling, storage, treatment, transportation, and/or disposal of petroleum hydrocarbon products and hydrocarbon-containing refinery process wastes.

455. Petroleum hydrocarbon products that have been discharged, leaked, spilled, placed, or otherwise disposed of into or on land or water constitute "discarded materials" that are a "solid waste" within the meaning of **RCRA Section 7003(a). See 42 U.S.C. §§ 6903(3), 6903(27), 6973(a). See Union Corp., 259 F. Supp. 2d. at 401-02; Aurora Nat'l Bank v. Tri Star Mktg., 990 F. Supp. 1020, 1027 (N.D. Ill. 1998) (J. Moran); Hill, 1998 WL 278291, at *3; see also Albany Bank & Trust Co. v. Exxon Mobil Corp., 310 F.3d 969 (7th Cir. 2002) (allegation of soil and groundwater contamination due to petroleum leak from neighboring gas station states *prima facie* RCRA endangerment claim); Zands v. Nelson, 779 F. Supp. 1254, 1262 (S.D. Cal. 1991) (gasoline leaked from tanks at gasoline stations constitutes a disposal of a solid waste under RCRA)**.

456. More generally, "Congress intended 'disposal' to have a range of meanings" including the leaking of wastes from inactive facilities. **Waste Indus., 734 F.2d at 164**. For instance, in Conservation Chem. Co., the court found there was disposal within the meaning of Section 7003 when the evidence showed that substances had migrated from the treatment ponds into the soil and groundwater.

619 F. Supp. at 200.

457. Hydrocarbon-containing refinery process wastes that have been discharged, leaked, spilled, placed, or otherwise disposed of into or on land or water also constitute "discarded materials" that are a "solid waste" within the meaning of **RCRA Section 7003(a). See 42 U.S.C. §§ 6903(3), 6903(27), 6973(a)**.

D. Defendant Apex Oil Co., Inc is a Person that has Contributed to such Handling, Storage, Treatment, Transportation, and/or Disposal.

458. Defendant Apex Oil Co., Inc. is a "person" that "has contributed to" the handling, storage, treatment, transportation, and disposal soil waste at the Hartford Site, within the meaning of **RCRA Section 7003(a). See 42 U.S.C. § 6973(a).** Under RCRA, the term "person" includes a "corporation." **See 42 U.S.C. § 6903(15)**.

459. Defendant Apex Oil Co., Inc. is such a "person" based on its status as the legal successor to Clark Oil and Clark Oil-Apex, consistent with principles of corporate successorship. **See North Shore Gas Co. v. Salomon Inc., 152 F.3d 642, 650 (7th Cir. 1998) (holding that a corporate successor is a "person" that can be held liable for environmental cleanup based on actions of its predecessors under the Comprehensive Environmental Response, Compensation, and Liability Act)**.

460. Consistent with RCRA's remedial purpose, the terms "contributed or . . . contributing to" should be construed liberally and broadly in a case under **Section 7003(a)**. **See Aceto, 872 F.2d at 1383-84 (referring to Webster's Dictionary's definition of "contributing," meaning "to have a share in any act or effect").**

<u>Accord</u>; <u>United States v. Price</u>, 523 F. Supp. 1055, 1073 (D.N.J. 1981), <u>aff'd</u> 688 F.2d 204 (3d Cir. 1982).

461. Clark Oil and Clark Oil-Apex discharged, spilled, and leaked hydrocarbons from their River Lines, which constituted "contributing to" the "disposal" of "solid waste" at the Hartford Site within the meaning of **RCRA Section 7003(a)**. **<u>See</u> 42 U.S.C. §§ 6903(3), 6903(27), 6973(a)**.

462. Clark Oil and Clark Oil-Apex discharged, spilled, and leaked hydrocarbons from their North Terminal Line, which constituted "contributing to" the "disposal" of "solid waste" at the Hartford Site within the meaning of **RCRA Section 7003(a)**. **<u>See</u> 42 U.S.C. §§ 6903(3), 6903(27), 6973(a)**.

463. Clark Oil and Clark Oil-Apex discharged, spilled, and leaked hydrocarbons in connection with their product recovery efforts in the Village of Hartford, which constituted "contributing to" the "disposal" of "solid waste" at the Hartford Site within the meaning of **RCRA Section 7003(a)**. **<u>See</u> 42 U.S.C. §§ 6903(3), 6903(27), 6973(a)**.

464. Clark Oil and Clark Oil-Apex discharged, deposited, spilled, and leaked hydrocarbons at the Hartford Refinery, which constituted "contributing to" the "disposal" of "solid waste" within the meaning of **RCRA 7003(a)**. **<u>See</u> 42 U.S.C. §§ 6903(3), 6903(27), 6973(a)**.

465. Some of the hydrocarbon materials that Clark Oil and Clark Oil-Apex disposed of at the Hartford Refinery also were "hazardous wastes" within the meaning

of **RCRA Section 7003(a)**. **<u>See</u> 42 U.S.C. §§ 6903(5), 6973(a)**.

466. Clark Oil and Clark Oil-Apex discharged, deposited, spilled, and leaked hydrocarbons at the Hartford Refinery, which constituted "contributing to" the "disposal" of "solid waste" within the meaning of **RCRA 7003(a)**. **<u>See</u> 42 U.S.C. §§ 6903(3), 6903(27), 6973(a)**.

467. Some of the "solid waste" that Clark Oil and Clark Oil-Apex discharged, deposited, spilled, and leaked at the Hartford Refinery has migrated beneath the Village of Hartford. Clark Oil and Clark Oil-Apex thereby "contributed to" the "solid waste" that may present an imminent and substantial endangerment at the Hartford Site.

468. Some of the "solid waste" that Clark Oil and Clark Oil-Apex discharged, deposited, spilled, and leaked at the Hartford Refinery remains beneath the Hartford Refinery property, but it may migrate beneath the Village of Hartford. Clark Oil and Clark Oil-Apex thereby "contributed to" the "solid waste" that may present an imminent and substantial endangerment at the Hartford Site.

E. Defendant Apex Oil Co., Inc is Jointly and Severally Liable for Taking Such Action as May Be Necessary to Abate the Hydrocarbon Contamination at the Hartford Site and All Associated Conditions that Present or May Present an Imminent and Substantial Endangerment to Health or the Environment.

469. Liability under **RCRA Section 7003** is joint and several where the harm is indivisible, so it is fully-appropriate for a single polluter to be held liable for abating an endangerment, even if the problem stems from multiple parties' commingled

wastes. **See** **Maine People's Alliance, 471 F.3d at 298 ("The joint and several nature of environmental liability makes it fitting to hold a single polluter responsible for the totality of the damage where, as here, the harm is indivisible."); Cox, 256 F.3d at 301 n.37; Conservation Chem, 619 F. Supp. at 199; Aurora Nat'l Bank, 990 F. Supp. at 1028**.

470. The same is true under the governmental enforcement provisions of other federal environmental laws like the **Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601-9675. See Rumpke of Ind., Inc. v. Cummins Engine Co., Inc., 107 F.3d 1235 (7th Cir. 1997) ("liability under [CERCLA] § 107(a) is joint and several. . ."); Metro. Water Reclamation Dist. of Greater Chicago v. N. Am. Galvanizing & Coatings, Inc., 473 F.3d 824, 827 & n.3 (7th Cir. 2007) ("liability under [CERCLA] § 107(a) is strict, joint and several," and the "only exception" is the "rare scenario" when "the harm is divisible")**.

471. The burden is on the defendant to show divisibility of the harm and thereby avoid joint and several liability. **See Centerior Serv. Co. v. Acme Scrap Iron & Metal Corp., 153 F.3d 344, 348 (6th Cir. 1998) (a defendant in a CERCLA Section 107(a) case can only avoid joint and several liability by "affirmatively demonstrat[ing] that the harm is divisible."); see also New Castle County v. Halliburton NUS Corp., 111 F.3d 1116, 1121 n.4 (3d Cir. 1997); United States v. Colorado & E. R.R. Co., 50 F.3d 1530, 1535 (10th Cir. 1995); O'Neil v. Picillo,**

883 F.2d 176, 178 (1st Cir. 1989). Given the nature of waste sites, "it is rare for a responsible party to be able to demonstrate divisibility of harm, and therefore joint and several liability is the norm." **Illinois v. Grigoleit Co., 104 F. Supp. 2d 967, 979 (C.D. Ill. 2000). Accord Centerior, 153 F.3d at 348; O'Neil, 883 F.2d at 183; Ninth Ave. Remedial Group v. Allis Chalmers Corp., 974 F. Supp. 684, 688 (N.D. Ind. 1997)**.

472. The Defendant is jointly and severally liable for addressing the hydrocarbon contamination at the Hartford Site pursuant to **RCRA Section 7003(a)**. The Defendant has not shown that the harm at the Hartford Site is divisible.

473. **RCRA Section 7003(a)** provides that the United States may seek and obtain an order that a liable party take any "action as may be necessary" to address an endangerment. **42 U.S.C. § 6973(a)**. In construing that broad mandate, the Third Circuit in Price rightly recognized that:

> Congress, in the endangerment provisions of RCRA . . . sought to invoke nothing less than the full equity powers of the federal courts in the effort to protect public health [and] the environment . . . from the pernicious effects of toxic wastes. Courts should not undermine the will of Congress by either withholding relief or granting it grudgingly.

688 F.2d at 214. Citing established Supreme Court precedent, the Price court also emphasized that a "court of equity has traditionally had the power to fashion any remedy deemed necessary and appropriate to do justice in the particular case." **688 F.2d at 211 (citing Hecht Co. v. Bowles, 321 U.S. 321, 329 (1944))**.

474. The injunctive relief in a RCRA imminent and substantial endangerment

case can include an order to perform further studies "to learn whether, in actuality, . . . contamination . . . adversely affects either human health or the environment." **Maine People's Alliance, 471 F.3d at 282**.

475. Traditionally, a party seeking entry of an injunction "must demonstrate: (1) that it has suffered an irreparable injury; (2) that remedies available at law, such as monetary damages, are inadequate to compensate for that injury; (3) that, considering the balance of hardships between the [parties], a remedy in equity is warranted; and (4) that the public interest would not be disserved by a permanent injunction." **eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 126 S. Ct. 1837, 1839 (2006)**. But "the operation of that framework is inevitably colored by the nature of the case and the purposes of the underlying environmental statute (here, RCRA)." **Maine People's Alliance, 471 F.3d at 296**. In a RCRA endangerment case, the traditional balancing of the equities at the relief stage is heavily influenced by "a congressional thumb on the scale in favor of remediation." **Id. at 297. See United States v. Bethlehem Steel Corp., 38 F.3d 862, 867 (7th Cir. 1994) (noting that "[o]rdinarily, a court is obligated to conduct an equitable balancing of harms before awarding injunctive relief, even under an environmental statute which specifically authorizes such relief" but nonetheless holding that "the district court properly ordered injunctive relief against Bethlehem without undertaking a weighing of the equities or making a finding of irreparable harm"); EPA v. Envtl. Waste Control, 917 F.2d 327, 332 (7th Cir. 1990) ("Where the plaintiff is**

a sovereign and where the activity may endanger the public health, injunctive relief is proper, without resort to balancing" (internal quotations omitted)).

476. In balancing the equities and considering the risk of harm if an injunction were not granted, the equitable balance tips strongly in favor of entry of the injunction sought by the United States. From the evidence at trial, it is clear that entry of the requested injunction would benefit the citizens of Hartford and promote the Congressionally-expressed public interest in "minimiz[ing] the present and future threat to human health and the environment" posed by solid and hazardous wastes. **42 U.S.C. § 6902(b)**. In contrast, the Defendant offered no evidence that it would suffer particular hardship (other than its obvious need to bear the cost of complying with the order). Finally, in a prior order in this case, this Court already held that **RCRA Section 7003(a)** "does not allow the government to seek pecuniary relief here," so there is no other adequate remedy available at law. **<u>United States v. Apex Oil Co., Inc.</u>, 438 F. Supp. 2d 948, 954 (S.D. Ill. 2006)**.

477. The Defendant is jointly and severally liable for taking such action as may be necessary to abate the hydrocarbon contamination at the Hartford Site and all associated conditions that present or may present an imminent and substantial endangerment to health or the environment, consistent with the specific terms of an injunction that are set forth below.

478. "When an equity case ends in a permanent injunction, the trial court, with or without an explicit reservation of jurisdiction, retains jurisdiction to enforce

the injunction, as by contempt proceedings." **McCall-Bey v. Franzen, 777 F.2d 1178, 1183 (7th Cir. 1985). Accord Shapo v. Engle, 463 F.3d 641, 643 (7th Cir. 2006)**. The Court retains jurisdiction for the purpose of enforcing its injunction in this case.

479. The Court's order and injunction does not resolve any other parties' potential joint and several liability for the hydrocarbon contamination at the Hartford Site, and does not relieve any other party of any obligations imposed by any legal requirement or agreement concerning the Hartford Site, such as obligations under the existing Administrative Order on Consent relating to the Site.

CONCLUSION

In summary, the Court finds that Apex Oil is jointly and severally liable for the contamination at the Hartford Site and orders Apex Oil to comply with the terms of the Injunctive Order attached hereto as Exhibit A.

IT IS SO ORDERED.

Signed this 28th day of July, 2008.

/s/ David R Herndon

Chief Judge
United States District Court